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Vol. 29, No. 9 SEPTEMBER 1960 Pages 335-374

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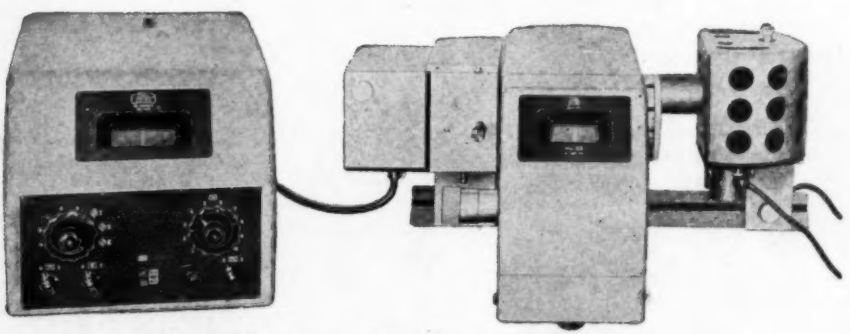

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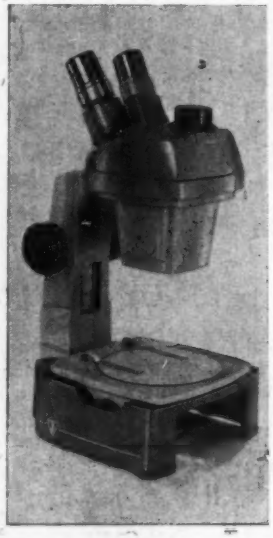

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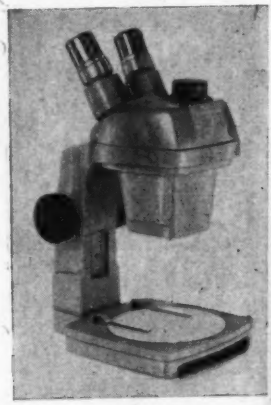

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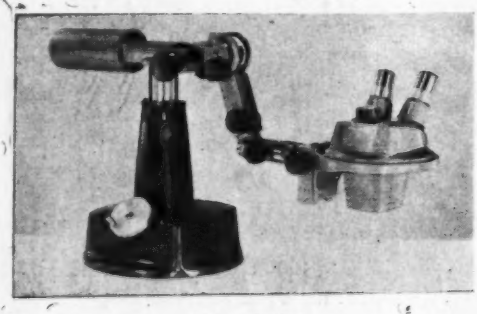

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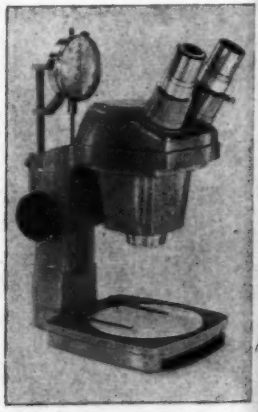

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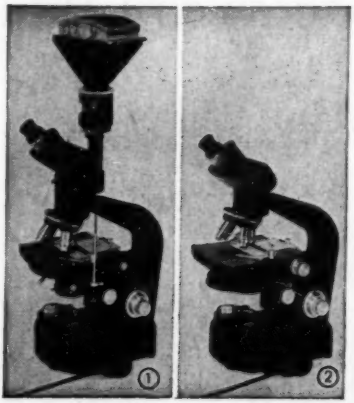

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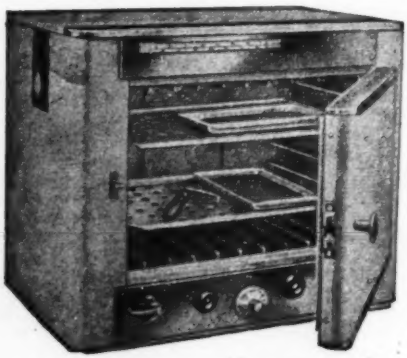

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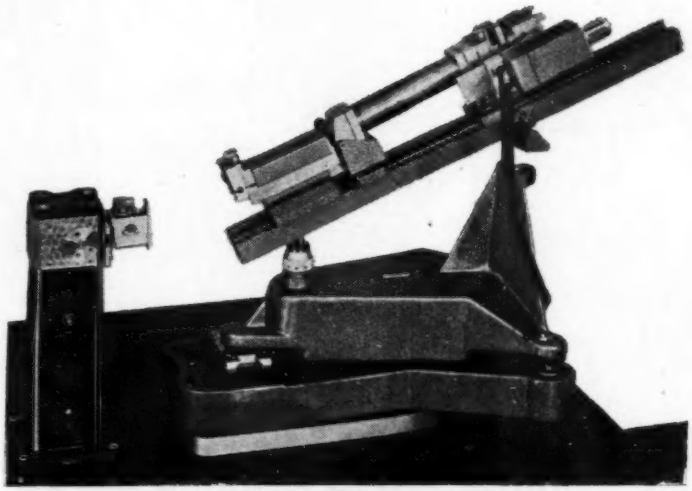

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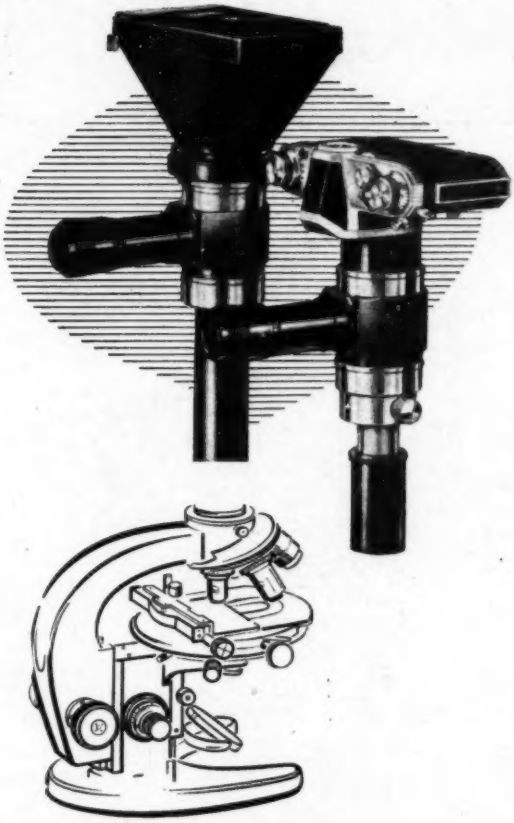

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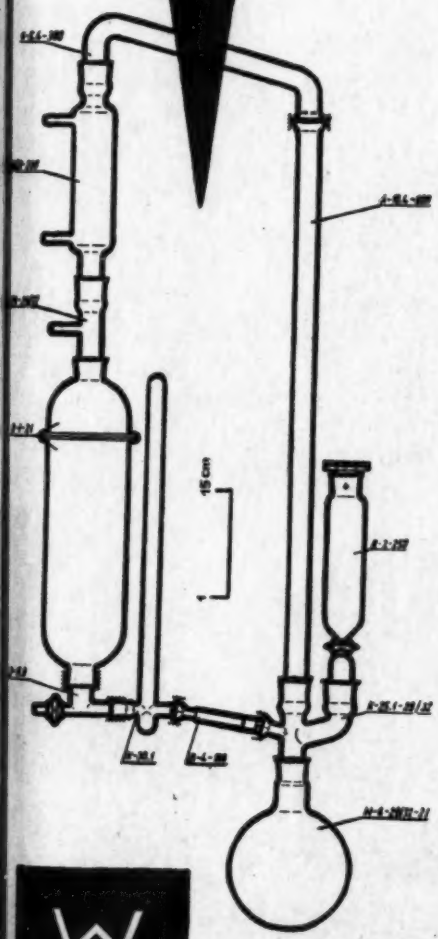

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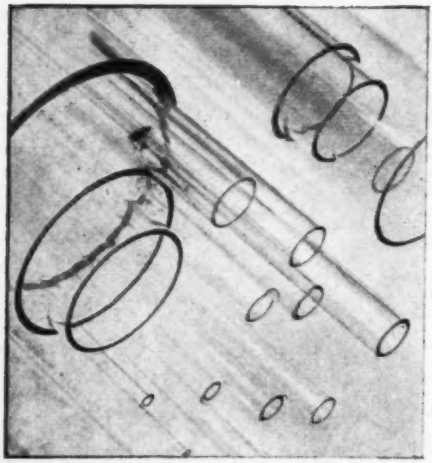

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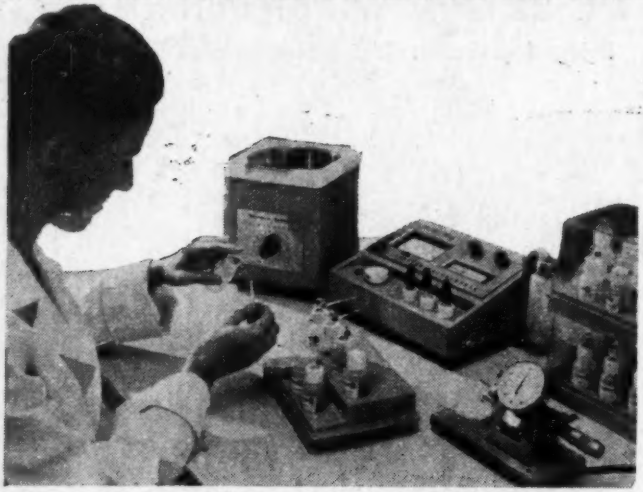

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INTERNATIONAL CONFERENCE ON NUCLEAR STRUCTURE

THE International Conference on Nuclear Structure for 1960 was held at Kingston, Ontario, Canada, from August 29 to September 3. The Conference was divided into 9 sessions.

In the first session on 'Open Problems in Nuclear Structure', R. E. Peierls (Birmingham) discussed the problem of nuclear forces from a theoretical standpoint. He pointed out that although the many-body problem is more complicated it can yield more information than the two-body problem. There were indications that one may have to consider velocity-dependent potential. D. H. Wilkinson (Oxford) discussed the problem from an experimental point of view. Even in the lightest nuclei the shell model seemed to break down. For instance, it was hard to understand the fast E 2 transition in O^{17}, which being a doubly closed shell *plus* one nucleon case would be expected to obey the shell model predictions. A similar instance was the existence of a O^+ state in C^{12}. Referring to the composition of the nuclear matter, he drew attention to the important part played by K^- absorption in nuclei, which mechanism was most sensitive to the tail in the density *versus* radius curve.

The second session on 'Physical Foundations of Nuclear Models', opened with a talk by K. A. Brueckner (California) on the nucleon-nucleon force. Brueckner described his work on nuclear matter with reference to applications to O^{16}, Ca^{40} and Zr^{90}. C. Bloch (France) pointed out that application of superfluidity to energy in nuclear matter may not be valid since the forces between electrons in a solid are quite different from nuclear forces in nuclei. A. de Shalit (Israel) spoke on his calculations of magnetic moments in which the neutron and proton were assigned different intrinsic magnetic moments. He cited the agreement with theory and suggested that the magnetic moment of Ca^{41} be measured and compared with that of K^{39}.

In the third session devoted to 'Gross Properties of Nuclear Matter', L. Rosen (Los Alamos) spoke on the polarisation in elastic scattering of neutrons and protons by complex nuclei and its interpretation in the light of the optical model. He indicated that no unique set of parameters was available and stressed the need for more data. D. Saxon (California) pointed out the necessity for including volume absorption in addition to surface absorption to explain polarisation, and elastic and total cross-sections. This, he said, can be accomplished without introducing any additional parameter but by simply including derivatives of the Gaussian potential.

In the fourth session on 'Nuclear Reaction Mechanisms' A. Zucker (Oak Ridge) referred to the discovery by the Chalk River group of a quasi-molecule in the reaction $C^{12} + C^{12}$. R. Eisberg (Minnesota) pointed out that all direct interactions can be explained in terms of a two-body force alone. N. Austern (Pittsburg) outlined the Distorted Wave Born approximation theory of nuclear reactions and compared it with experiment.

The fifth session on 'Properties of Individual Levels', opened with a talk by E. B. Paul (Harwell) on nuclei in the *lp* shell. The shell model seemed to be again in difficulties. For instance the spin of Be^{11} was $\frac{1}{2}^+$ instead of being $\frac{1}{2}^-$. Further, it was difficult to reconcile the O^+ state in C^{12} with the shell model. Regarding the validity of the cluster model as proposed by Wildermuth and others he suggested that experiments on reduced alpha widths and matrix elements for gamma emission between states of the same cluster parentage may be decisive. M. K. Banerjee (India) described recent work by his group at Princeton on shell model calculations in intermediate coupling in second order perturbation theory. The impressive agreement with experimental data seemed to show promise for this approach. H. E. Gove (Chalk River) surveyed the systematics of nuclei between O^{16} and Ca^{40}, discussing in particular quadrupole moments, magnetic dipole moments, reduced electric transition probabilities and lifetimes. Nilsson's model seemed to be remarkably successful in explaining these properties. Gove referred to a rather surprising result in the case of P^{29} where 5% M 3 admixture had been observed in an E 2 transition.

In the sixth session, B. R. Mottelson (Copenhagen) discussed collective motion in the nucleus. I. Perlman (Berkeley) spoke on single particle states in deformed nuclei and pointed out the excellent agreement with the Nilsson classification in the case of Bk^{249} studied from the alpha decay of E^{253}. The levels of odd-odd nuclei also seemed to favour this model. Groshev (U.S.S.R.) described his experiments on the neutron capture by Cd^{113}. A new O^+ level in Cd^{114} (same as seen by B. L. Cohen) was found which did not exhibit collective behaviour in contrast to a lower O^+ excited state in the same nucleus.

In the seventh session on 'Statistics of Nuclear Levels', J. P. Schiffer (Argonne) spoke on strength functions and gross structure. He pointed out how (d, p), (α, t) and (n, p) reactions can be used to excite and identify single-particle levels. He referred to the interesting fact that the coulomb barrier for incoming charged particles agreed with expectations whereas for outgoing particles the barrier appeared to be lower. J. S. Levinger (Louisiana) spoke briefly on the photonuclear experiments of Fuller and Hayward which showed evidence of nuclear Raman effect.

The eighth session was an open session presided over by B. H. Flowers. P. H. Stelson (Oak Ridge) surveyed the systematic properties of excited states of even-even nuclei, in particular, spins, energy ratios and transition probabilities, in the light of various nuclear models. He referred to the absence of the triplet structure in several nuclei. The experimental data seemed to favour the rotational model of Davydov and Filippov. This was followed by a talk by A. S. Davydov (U.S.S.R.) who described his new rotational model, incorporating two parameters—μ to specify the deviation from the adiabatic condition and γ to specify the deviation from axial symmetry. In particular he mentioned the predictions of his new theory regarding the electric monopole matrix element ρ in a 2'–2 transition and stressed the need for more experiments to test these predictions. The values already known for Cd^{114} and Pt^{196} were not inconsistent with his predictions.

The final session was devoted to fission in relation to nuclear structure followed by a summary of the Conference by A. Komar (U.S.S.R.) and V. F. Weiskopf (M.I.T.).

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STUDIES IN THEORETICAL PHYSICS*

THESE studies consisting of two parts relate to papers presented at the first Summer School of Theoretical Physics organised in India last year under the auspices of the Ministry of Scientific Research and Cultural Affairs.

There are altogether thirty-two papers published in the *Proceedings* of which ten relate to quantum field theory, nine to nuclear physics, five each to statistical mechanics and cascade showers, and three to strange particles. Of these only three papers appear to have elicited some kind of a discussion whereas we expected this to follow most of the papers, for, in a summer school of this type discussions play as vital a role as the presentation of the author's work. This absence of discussions appears to be a consequence of the wide range over which the topics have been distributed, and although perhaps unavoidable at a first summer school, we would have liked to have seen a kind of exclusion principle operating so as to lay emphasis on one or two topics only, specially on the subject of elementary particles which is holding the centre of interest in present day theoretical physics.

Most of the papers are of an expository nature, but constitute excellent reviews of the present state of knowledge in the topics dealt with. The papers on Brueckner's theory of the nucleus, on the nuclear shell model, on strange particles, on the theory of cascade showers, and on stochastic processes fall under this category. Even where the papers are of an expository character, the exposition has been made valuable indicating new points of view, and inclusion of the author's own original work. Thus the paper on the connection between spin and statistics introduces the notion of relativistic invariance extended to complex parameters of the Lorentz group. The paper on nucleon-antinucleon scattering shows the possibility of using meson theory directly to explain important phenomena. Papers on stripping types of nuclear reactions, on low energy nuclear phenomena and on neutron-proton scattering present some original ideas. The paper on the stochastic problem of electron-photon cascades breaks new ground by including polarisation. The paper on statistical mechanics and the theory of numbers indicates a generalisation of Ingham's Tauberian theorem for partitions. Similarly, the paper on polymers and the theory of numbers contains interesting original work, and should interest the purest of pure mathematics. Many of the other papers also contain new ideas of varying importance.

There can be no doubt that this Summer School has served a most useful purpose, and has been instrumental in encouraging research in theoretical physics in the country.

B. S. M.

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A PROPOSED STANDARD SYSTEM OF NOMENCLATURE OF HUMAN MITOTIC CHROMOSOMES

(Communicated by Arthur Robinson, M.D., University of Colorado)

THE rapid growth of knowledge of human chromosomes in several laboratories, following advances in technical methods, has given rise to several systems by which the chromosomes are named. This has led to confusion in the literature and so to the need for resolving the differences. Consequently, at the suggestion of Dr. C. E. Ford, a small study group was convened to attempt the formulation of a common system of nomenclature. The meeting was arranged, through the good offices of Dr. T. T. Puck, to be held at Denver, in the University of Colorado, under the auspices of the Medical School. The meeting of this study group was made possible by the support of the American Cancer Society, to whom grateful thanks are due. For practical reasons, it was decided to keep the group as small as possible and to limit it to those human cytologists who had already published karyotypes.* In addition, three counsellors were invited to join the group to guide and aid the discussions and, if necessary, to arbitrate. Fortunately, the last office did not prove necessary, and it was possible by mutual agreement to arrive at a common system which has flexibility.

It was agreed that the principles to be observed by the system should be simplicity and freedom, as far as possible, from ambiguity and risks of confusion, especially with other systems of nomenclature in human genetics. It should also be capable of adjustment and expansion to meet the needs of new knowledge of human chromosomes. The system should be agreed to by the greatest possible proportion of cytologists working in the field, but the risk that a minority may be unable to accept the system as a whole should not be allowed to delay adoption by a majority.

It was agreed that the autosomes should be serially numbered, 1 to 22, as nearly as possible in descending order of length, consistent with operational conveniences of identification by other criteria. The sex chromosomes should continue to be referred to as X and Y, rather than by a number, which would be an additional and ultimately, a superfluous appellation.

It was generally agreed that the 22 autosomes can be classified into seven groups, distinction between which can readily be made. Within these groups, further identification of individual chromosomes can in many cases be made relatively easily. Within some groups, especially the group of chromosomes numbered 6-12, including also the X-chromosome, the distinctions between the chromosomes are very difficult to make by presently available criteria. However, lesser difficulties are encountered in separating chromosomes 6 and the X from the remainder of this group. It is believed that with very favourable preparations, distinction can be made between most, if not all, chromosomes.

It is proposed that the autosomes first be ordered by placing the seven groups as nearly as possible in descending order of size. Within each group the chromosomes are arranged, for the most part, by size. It was desired specifically to avoid the implication that size relationships have been permanently decided in every instance, but it is hoped that the assignment of numbers will be permanently fixed. In those cases where distinction is at present doubtful, final definition of each chromosome can be left until further knowledge has accrued, though an attempt is made to provide a characterization of each. These principles make it possible to draw up a conspectus of the chromosomes, a table of their quantitative characteristics and a table of the synonyms which authors have already published. These are given in Tables I, II and III.

In Table II, showing the diagnostic characters of the chromosomes, three parameters are relied upon. These are: (1) The length of each chromosome relative to the total length of a normal, X-containing, haploid set, i.e., the sum of the lengths of the 22 autosomes and of the X-chromosome, expressed per thousand; (2) The arm ratio of the chromosomes expressed as the length of the longer arm relative to the shorter one; and (3) The centromeric index

* In contemporary publications the terms, karyotype and idiogram, have often been used indiscriminately. We would recommend that the term, *karyotype*, should be applied to a systematized array of the chromosomes of a single cell prepared either by drawing or by photography, with the extension in meaning that the chromosomes of a single cell can typify the chromosomes of an individual or even a species. The term, *idiogram*, would then be reserved for the diagrammatic representation of a karyotype, which may be based on measurements of the chromosomes in several or many cells.

expressed as the ratio of the length of the shorter arm to the whole length of the chromosome. The two latter indices are, of course, related algebraically quite simply, but it is thought useful to present both here. In some chromosomes, the additional criterion of the presence of a satellite is available (Table I), but in view of the apparent morphological variation of satellites, they and their connecting strands are excluded in computing the indices.

TABLE I

Conspectus of human mitotic chromosomes

Group 1-3	Large chromosomes with approximately median centromeres. The three chromosomes are readily distinguished from each other by size and centromere position.
Group 4-5	Large chromosomes with submedian centromeres. The two chromosomes are difficult to distinguish, but chromosome 4 is slightly longer.
Group 6-12	Medium-sized chromosomes with submedian centromeres. The X-chromosome resembles the longer chromosomes in this group, especially chromosome 6, from which it is difficult to distinguish. This large group is the one which presents major difficulty in identification of individual chromosomes.
Group 13-15	Medium-sized chromosomes with nearly terminal centromeres ("acrocentric" chromosomes). Chromosome 13 has a prominent satellite on the short arm. Chromosome 14 has a small satellite on the short arm. No satellite has been detected on chromosome 15.
Group 16-18	Rather short chromosomes with approximately median (in chromosome 16) or submedian centromeres.
Group 19-20	Short chromosomes with approximately median centromeres.
Group 21-22	Very short, acrocentric chromosomes. Chromosome 21 has a satellite on its short arm. The Y-chromosome is similar to these chromosomes.

Table II shows the range of measurements determined by various workers. Some of the variation expresses the uncertainty due to measurement of relatively small objects; but many of the discrepancies between different workers' observations are due to the measurement of chromosomes at different stages of mitosis and to the effect of different methods of pretreatment and preparation for microscopic study. The ranges shown, therefore, represent the maxima and minima of the means found by different workers using different techniques. However, within any one worker's observations, the variations are not so broad.

Reference should be made to two other matters of nomenclature. In the first place, it is considered that no separate nomenclature for the groups is needed. It is considered that any group to which it may be necessary to refer will be a sequence of those designated by Arabic numerals. Hence, any chromosome group may be referred to by the Arabic numerals of the extreme chromosomes of the group, joined together by a hyphen, *e.g.*, the group of the three longest chromosomes would be Group 1-3. This scheme has the merit of great flexibility. For instance, chromosomes X and 6 may be separated from the Group 6-12 whenever they can be distinguished.

Secondly, there is the problem raised by the abnormal chromosomes which are being encountered in the more recent studies. Their nomenclature was discussed without a definite conclusion being reached. Broadly, it was agreed, however, that any symbol used should avoid incorporating a specific interpretation which was not reasonably established. It was suggested that arbitrary symbols, prefixed by a designation of the laboratory of origin, should usually be assigned to the abnormal chromosome.

In this connection, two further requisites for co-ordination of research were discussed. One is the storage of documentation for reference, perhaps in a central depository, additional to what it may be possible to publish. The other is the desirability that cultures be preserved, by the satisfactory methods now used, so that they are available for reference, comparison and exchange.

Some consideration was also given to the desirability of using a uniform system for presenting karyotypes and idiograms, but recognizing that individual variation in taste is involved, rigidity of design was thought undesirable. However, it was recommended that the chromosomes should be arranged in numerical order, with the sex chromosomes near but separated from the autosomes they resemble. It is desirable that similar ones be grouped together with their centromeres aligned.

It is recognized that choice between the different possible schemes of nomenclature is arbitrary, but that uniformity for ease of reference is essential. Hence, individual preferences have been subordinated to the common good in reaching this agreement. This human chromosomes study group therefore agreed to use this notation and recommends that any who prefer to use any other scheme should, at the same time, also refer to the Standard System, proposed here.

We are well aware of the wide interest in the work of this study group and realize that this meeting is merely a preliminary to a larger meeting. It is believed that two needs have to be met in this respect. One is for seminars and workshops at which workers in the field may exchange information; such seminars are best arranged regionally. The second need, which may come later, is for international conferences; and we believe that Congresses and other organizations whose interests include human genetics, should promote such meetings.

Table II

Quantitative characteristics of the human mitotic chromosomes

All measurements were made from cells of normal individuals, except those made by Fraccaro and Lindsten, which included cases of Turner's Syndrome. The column A is the relative length of each chromosome, B is the arm ratio and C the centromere index, as defined in the text

	Tjio and Puck[6]			Chu and Giles[2]			Levan and Hsu[5]			Fraccaro and Lindsten*			Lejeune and Turpin[4,9]			Buckton, Jacobs and Harnden*			Range		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1	90	1·1	48	90	1·1	48	85	1·1	49	82	1·1	48	87	1·1	48	83	1·1	48	82-90	1·1	48-49
2	82	1·6	39	83	1·5	40	79	1·6	38	77	1·5	40	84	1·5	40	79	1·6	38	77-84	1·5-1·6	38-40
3	70	1·2	45	72	1·2	46	69	1·2	45	65	1·2	45	67	1·2	46	63	1·2	46	63-72	1·2	45-46
4	64	2·9	26	63	2·9	26	63	2·7	27	62	2·6	28	62	2·6	25	60	2·6	28	60-64	2·6- 2·9	25-28
5	58	3·2	24	58	3·2	24	59	2·6	28	60	2·4	29	57	2·4	30	57	2·4	30	57-60	2·4- 3·2	24-30
X	59	1·9	24	57	2·8	38	52	1·6	38	54	1·6	38	58	2·2	32	51	1·7	37	51-59	1·6- 2·8	32-38
6	55	1·7	37	56	1·8	36	56	1·7	37	54	1·6	28	56	1·7	37	56	1·6	38	54-56	1·6- 1·8	36-38
7	47	1·3	43	52	1·9	35	51	1·9	35	50	1·7	37	51	1·8	36	50	1·7	37	47-52	1·3- 1·9	35-43
8	44	1·5	29	46	1·7	29	48	1·6	33	47	1·7	37	48	2·4	29	46	1·5	40	44-48	1·5- 2·4	29-40
9	44	1·9	40	46	2·4	38	47	1·8	36	45	2·0	33	47	1·9	35	44	2·1	32	44-47	1·8- 2·4	32-40
10	43	2·4	27	45	2·3	30	45	2·0	33	45	2·6	24	45	2·6	27	44	1·9	35	43-45	1·9- 2·6	27-35
11	43	2·8	34	44	2·1	32	44	2·2	31	43	2·2	31	44	1·6	39	43	1·5	40	43-44	1·5- 2·8	31-40
12	42	3·1	24	43	3·1	24	42	1·7	32	43	1·7	37	42	2·8	27	42	2·1	32	42-43	1·7- 3·1	24-37
13	35	8·0	11	32	9·7	10	32	5·0	16	34	4·8	17	33	6·8	14	36	4·9	17	32-36	4·8- 9·7	10-17
14	32	7·3	12	34	9·5	9	37	4·0	18	35	4·4	19	32	7·0	13	34	4·3	19	32-37	4·3- 9·5	9-19
15	29	10·5	9	31	11·9	8	35	4·7	17	33	4·6	22	31	10·0	9	34	3·8	22	29-35	3·8-11·9	8-22
16	22	1·8	36	27	1·6	38	30	1·4	42	31	1·4	42	29	1·4	41	33	1·4	31	27-33	1·4- 1·8	31-42
17	29	2·8	26	30	2·1	33	29	2·4	30	30	1·9	35	29	3·1	23	30	1·8	36	29-30	1·8- 3·1	23-36
18	24	3·8	21	25	3·8	22	25	2·6	28	27	2·5	29	26	4·2	21	27	2·4	29	24-27	2·4- 4·2	21-29
19	22	1·4	41	22	1·9	34	24	1·2	40	25	1·3	43	22	1·4	42	26	1·2	45	22-26	1·2- 1·9	34-45
20	21	1·3	44	19	1·3	44	21	1·2	40	23	1·3	43	20	1·2	43	25	1·2	46	19-25	1·2- 1·3	40-46
21	18	3·7	21	15	6·8	13	13	2·5	38	16	2·5	29	15	2·3	31	20	2·5	29	13-20	2·3- 6·8	13-31
22	17	3·3	23	12	6·0	14	16	2·0	33	17	2·3	30	13	4·0	20	18	2·7	27	12-18	2·0- 6·0	14-33
Y	19	∞	0	11	∞	0	18	4·9	17	22	2·9	26	18	∞	0	18	4·9	17	11-22	2·9-∞	0-26

* Unpublished data.

TABLE III

Synonymy of chromosomes as published by various workers

New chromosome number	Tjio and Puck[6]	Chu and Giles[2]	Levan and Hsu[5]	Ford, Jacobs and Lajtha[3]	Böök Fraccaro and Lindsten[1]	Lejeune, Turpin and Gautier[4]
1	1	1	1	1	1	G1
2	2	2	2	2	2	G2
3	3	3	3	3	3	G3
4	4	4	4	4	4	G4
5	5	5	5	5	5	G5
6	6	6	6	6*	6	M1
7	7	7	7	(8)	7	M2
8	8	8	8	(9)	8	Md1
9	9	9	9	(11)	9	M3
10	10	10	10	10	10	Md2
11	11	11	11	(12)	11	M4
12	12	12	12	(13)	12	Md3
13	18	14	20	14	14	T1
14	19	15	18	15	15	T2
15	20	13	19	16	13	T3
16	13	17	15	19	16	C1
17	14	16	13	17	17	P1
18	15	18	14	18	18	P2
19	16	19	16	20	19	C2
20	17	20	17	21	20	C3
21	21	21	22	22	21	Vh
22	22	22	21	23	22	Vs
X	X	X	X	?(7)	X	X
Y	Y	Y	Y	Y	Y	Y

* In the published *idiogram* the chromosomes of group 6–12 (including X) were indicated by discontinuous lines and left unnumbered owing to the uncertainty of discrimination at that time. For the purpose of this table, these chromosomes have been assigned the numbers shown in brackets, in serial order of length.

1. Böök, J. A., Fraccaro, M. and Lindsten, J., "Cytogenetical observations in Mongolism," *Acta Pædiatrica*, 1959, **48**, 453.
2. Chu, E. H. Y. and Giles, N. H., "Human chromosomes complements in normal somatic cells in culture," *Am. J. Hu. Genetics*, 1959, **11**, 63–79.
3. Ford, C. E., Jacobs, P. A. and Lajtha, L., "Human somatic chromosome," *Nature*, 1958, **181**, 1565.
4. Lejeune, J., Turpin, R. and Gautier, M., "Le Mongolisme, premier exemple d'aberration autosomique humaine," *Ann. Génét.*, 1959, **2**, 41–49.
5. Levan, A. and Hsu, T. C., "The human idiogram," *Hereditas*, 1959, **45**, 665–72.
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THE UPTAKE AND REDUCTION OF IODATE BY WHEAT-ROOTS

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INVESTIGATING the toxic characteristic of halogenate anions, Aberg[1] put forward the idea that in plant tissues the iodate is reduced to iodide and its toxic activity is shown in this form. So far we have been at a loss in producing proofs about the iodate-iodide transformation possibly because the reaction, owing to the slow rate of iodate uptake, could not be studied by means of traditional chemical analytical methods under physiological conditions (diluted solutions, relatively short experimental period).

In our experiments we used I^{131}-iodate made from I^{131}-iodide by means of chlorine gas. The free chlorine left in the solution was boiled out and the hydrochloric acid formed during the reaction was neutralized by KOH. Investigating the iodate solution produced, by adopting paper chromatography, we obtained only 0·4% iodide

contamination; apart from chloride there was no other anion to be found.

In the uptake experiments the excised roots of 20 F. 481 winter wheat seedlings grown at 26° C. for 3 days in darkness were used in each variant. The uptake was made from a continually aerated solution of 100 ml. kept at room temperature and it took 6 hours. At the end of the experimental period the roots were washed twice in 50 ml. distilled water. Then the material was homogenized in 96% ethyl alcohol and after filtering, the rest was washed in 80% ethyl alcohol and distilled water. The washing solution was added to the original filtrate. The rest of the alcohol extraction was put for 24 hours in 0·2 N NaOH and then it was filtered and washed again. After filtering and washing, samples were made from the rest and both from the alcoholic and basic extracts, and their activity was measured by 1·3 mg./cm.^{2} end-window GM tube. (Data given about the activity of the rest are only of informatory value, since the self-absorption of samples have not been taken into account.) The chromatography of the alcoholic extract was carried out on Whatman 1 paper with 5 : 1 : 2 n-butanol : etanol : 2 N NH_4OH. Autoradiograms of the chromatograms were made on "Forte" high speed X-ray sheets.

In the first experiment an iodate solution of 100 μC activity and a concentration of about 0·1 m. equiv./l. was given in each 100 ml. variant. The variants were as follows: (1) control, (2) control killed by boiling, (3) 10^{-3} M Na-azide, (4) 50 m. equiv./l KNO_3 (see Table I). Using Na-azide the uptake decreased to 18% of the control, nitrate resulted in a reduction to 44% The chromatographic data indicate that the majority of the alcoholic-water extract can be found in the iodide spot (R_f 0·35) and only traces of iodate can be detected (R_f 0·04).

TABLE I

Iodate uptake by wheat roots

Variant	Uptake, counts per minute alcoholic extract	basic extract	the rest
Control	11070	1590	83
10^{-3} M Na-azide	2000	340	8
50 m. equiv./l. KNO_3	4920	700	33
roots boiled	6020	1450	52

In the control variant where there was the greatest uptake, spots are visible at 0·15, 0·21, 0·45, 0·63, 0·81 R_f as well as just under the front line. Comparing data with those of iodide uptake, by wheat-roots (Böszörményi and Cseh[2]) striking differences could be found, particularly in the high R_f compounds (Fig. 1).

In the second experiment a solution composed of 2·5 m. equiv./l. iodate with an activity of 35 μC. was used for incubating intact and boiled roots. During the 6-hour experiment the intact roots took up 0·43 μ equiv. that is 0·17% of the given quantity of iodate. The absorbed quantity, as shown by chromatography, consists almost entirely of iodide, since, because of reduced specific activity, organic compounds of weaker activity cannot be demonstrated in experiments of this type. Surprisingly the "uptake" of boiled roots was of 1·00 μ equiv. and it is mostly iodate with some iodide. In our view the "uptake" of boiled roots is but external solution penetrating the tissues and hardly can it be eliminated by rapid washing.

A B

FIG. 1. Pattern of iodine compounds on chromatograms after the uptake of iodate (A) and iodide (B).

By the end of the 6-hour experiment the I^{131} contents of the external solution appeared to be almost entirely of iodate, apart from some iodide traces. The experimental solution of boiled roots, however, showed somewhat higher iodide contents.

1. Aberg, B., *Roy. Agr. Coll. Sweden*, **1948**, **15**, 38.
2. Böszörményi, Z. and Cseh, E., *Naturwiss.*, **1959**, **46**, 584.

GROWING *COLOCASIA* EMBRYOS IN CULTURE

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COLOCASIA ESCULENTA, commonly known as taro or dasheen, is an important tuber crop extensively cultivated in most tropical countries and is used as a subsidiary food. Several varieties of it are grown in India, China, Japan, Florida and Hawaii and other Pacific Islands. The only method of propagation known in this is vegetative, either the main root stock or the smaller side tubers being used for this purpose. Though the plant sets seeds they have never been seen to germinate in nature and the plant has so far been considered sterile. This possibly explains why no breeding work has been done on this important crop so far.

The sterility in *Colocasia antiquorum* has been investigated previously by Maeda[4] and Banerji.[1,2] Maeda determined the haploid chromosome number as $n = 14$ and also observed certain irregularities in the microsporogenesis of the plant and suggested that this might be the cause of the sterility. Banerji[1] suggested the non-formation of seeds in *C. antiquorum* as being due to the nondevelopment of the female gametophyte. Later he (Banerji[2]) studied the micro- and mega-sporogenesis in the plant in detail. He confirmed Maeda's findings regarding the irregularities in microsporogenesis and also gave a detailed account of the degeneration of the female gametophyte, which he considered to be responsible for the sterility.

During the past four years the cytology of 15 varieties of *Colocasia esculenta* and two varieties of *C. antiquorum* have been studied. In both species, it was found that the somatic chromosome number in the diploids is 28 and in the triploids 42. The microsporogenesis in both diploids and triploids were investigated. In the diploids it was found that the course of meiosis was regular, the abnormalities reported by Maeda and Banerji being observed only rarely and probably accountable by variations in temperature or other environmental factors. In any case, these few abnormalities could not account for the reported sterility in the diploid plants. The pollen grains were over 90% normal and completely filled as indicated by staining tests with iodine and acetocarmine. Germination tests also showed that the pollen grains are normal and viable. The development of the fruit and seeds also appeared normal.

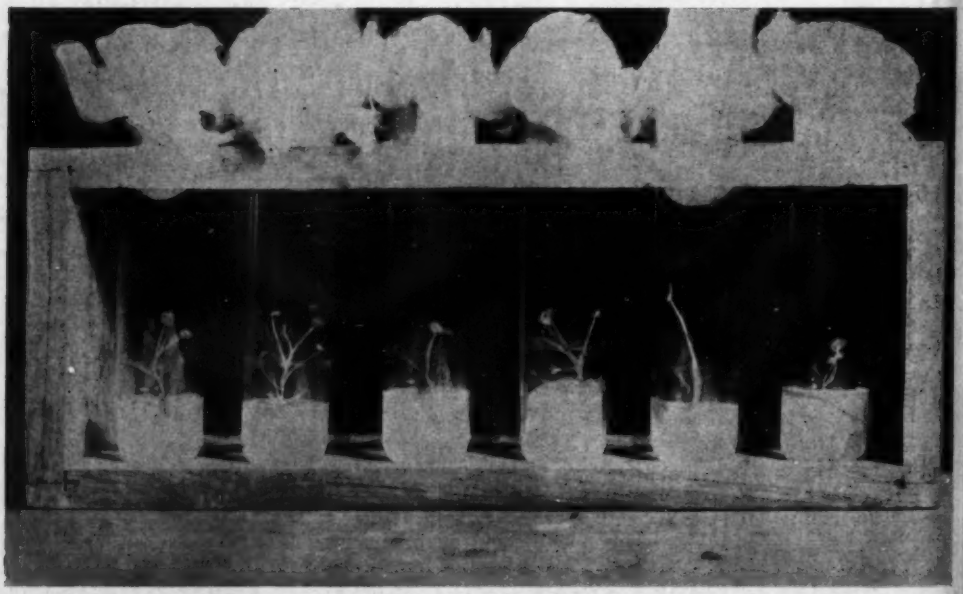

FIG. 1. Culture tubes containing 4 weeks-old seedlings of *Colocasia antiquorum* (3 on the left) and *C. esculenta* (3 tubes on the right).

Aborting seeds or seeds without embryos were only seldom seen. The seeds though small were fully developed. The embryos, which are small, are well formed and not shrivelled as in the case of really abortive seeds. They range in size between 0·6 mm.–0·9 mm. in length and 0·3 mm.–0·4 mm. in diameter. It was felt that seeds fail to germinate under ordinary treatments probably due to some unfavourable conditions and therefore embryo-culture technique was tried.

The fruits of diploid plants of *Colocasia esculenta* and *C. antiquorum* were sterilized by dipping in 90% alcohol and flaming. The embryo was dissected out under a binocular microscope. By holding the seed gently pressed down with one needle, the testa is broken with another at the micropylar end and by a gentle pressure over the seed the embryo slides out of the endosperm. It sticks to the needle and is easily transferred to the culture tubes containing modified White's medium autoclaved and sterilised as usual.

During the first four to six days the embryos showed little visible change. But later growth was rapid and in 20-30 days the seedlings had grown over an inch in height with four to five small leaves. They were then transferred to soil in pots and developed into normal healthy plants. Among the plants thus raised appreciable variation in easily recognisable morphological characters was noted. This may be due to the heterogeneous nature of the parent plant or due to natural cross-pollination.

It is clear that the sterility in *Colocasia* is not the result of either microspore or megagametophyte abortion, as previously reported, or due to the disturbed embryo, endosperm and pericarp relations ("somatoplastic sterility" of Cooper and Brink[3]) as in the case of interspecific hybrids. In *Colocasia* the embryo reaches full growth in the seed. The embryo fails to develop into seedling under ordinary conditions probably because the food supply from the endosperm is inadequate or due to other causes still unknown.

The present investigation clearly shows that cultivated as well as wild strains of diploid *Colocasia* species produce normal viable embryos and it is easy to raise seedlings from them by embryo-culture technique. This opens up possibilities of improvement in this crop by intervarietal and interspecific hybridisation. Work on this is in progress in this laboratory.

This work was done under a scheme of research on Miscellaneous Tuber Crops financed by the Indian Council of Agricultural Research.

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ORIGIN OF THE SOLAR SYSTEM

NOTWITHSTANDING the fact that the origin of the solar system has been the subject of scientific investigation from century to century, it may truly be said that the problem is yet unsolved and is likely to remain a perpetual one. Any theory of the origin of the solar system should explain in a consistent manner the considerable degree of order that is observed in it. In this context the new approach suggested by Woolfson (*Nature*, 1960, 187, 47) deserves notice. The model which he proposes for the formation of the solar system, in common with some others which have been advanced, envisages the passage of a star into the neighbourhood of the Sun. He considers a star of one hundred Sun masses moving with a velocity of 100 km./sec. and approaching the Sun to within a distance of ten times the solar radius.

The Sun is imagined as initially spinning about an axis not in the plane of the orbit of the star. A tide is raised on the surface of the Sun which increases in height as the star approaches. Eventually a position is reached where a portion at the tip of the tidal bulge facing the star is under a greater gravitational pull from the star than from the Sun itself, and this portion then breaks away and, moving under the combined gravitational attractions of the star and the Sun, forms the planet Pluto.

This loss of material at the solar surface sets up waves which will travel around the Sun from the unaffected obverse tidal bulge towards that part of the Sun facing the oncoming star. The wavecrest approaches the oncoming star which eventually draws off another portion of the solar material to form the planet Neptune. A new wave is initiated to give the planet Uranus, and then Saturn and Jupiter are formed in a similar way. At this stage the star is approaching most closely and is able to draw material out from the Sun almost continuously, a great deal of which material it may even capture. Indeed a large planet could have been formed at this stage and captured by the star. The residue of the ejected material forms the belt of asteroids, which lie for the most part between the orbits of Jupiter and Mars. Finally, as the star recedes, the four smaller planets—Mars, Earth, Venus and Mercury—are formed.

LETTERS TO THE EDITOR

ELECTRONIC SPECTRA OF *o*-, *m*- AND *p*-CHLOROBENZALDEHYDES

THE near ultra-violet absorption and emission spectra of benzaldehyde have been reported previously. Imanishi *et al.*,[1] and later, Garg[2] studied the absorption spectrum of benzaldehyde vapour and Robinson[3] has reported the emission spectrum. Raman spectrum of benzaldehyde has been studied by Kohlrausch.[4] Padhye and Viladkar[5] have analysed the infra-red spectrum of benzaldehyde and have assigned most of the fundamentals to definite modes of vibration. It was considered interesting to study the electronic and vibrational spectra of halogenated benzaldehydes to understand the effect of substitution. Vibrational spectra of the three isomeric chlorobenzaldehydes have been reported previously.[5] The near ultra-violet absorption spectra of chlorobenzaldehyde vapours, and a reassignment of the corresponding benzaldehyde vapour spectrum in the light of this study are reported here.

The *o*-, *m*- and *p*-chlorobenzaldehydes have three regions of absorption. The first one near about 3750 Å, the central one at 2900 Å and shortest wavelength one at about 2500 Å. A preliminary report on these molecules has been published by Patel.[6] The data regarding the 2900 system have been extended and the longest wavelength spectrum has been recorded and analysed.

The 2900 band system in chlorobenzaldehydes arises out of $\pi^* \leftarrow \pi$ transition and corresponds to 2600 Å system of benzene. In *ortho*- and *meta*-chlorobenzaldehyde belonging to C_s symmetry, the $B_{2v} \leftarrow A_{1g}$ transition in benzene reduces to an allowed $A' \leftarrow A'$ transition and in *para*-chlorobenzaldehyde belonging to approximate C_{2v} symmetry it reduces to $B_2 \leftarrow A_1$**

The strongest bands at 33468, 33791 and 35097 cm.$^{-1}$ have been assigned as *o,o* bands in *ortho*-, *meta*-, and *para*-chlorobenzaldehydes respectively. This is substantiated by the temperature effect studied for the band system. The excited state frequencies which explain the major portion of the spectrum are 654, 975, 1059 and 1188 cm.$^{-1}$ in *ortho*, 677, 969, 1096 and 1193 cm.$^{-1}$ in *meta* and 667, 798, 1071 and 1198 cm.$^{-1}$ in *para*-isomer. The frequencies near 660 and 970 cm.$^{-1}$ in *ortho* and *meta* and the one near 798 observed only in *para* case depend characteristically on the special orientation of substituents. These excited state frequencies are correlated to the ground state frequencies whose modes of vibrations possibly explain their characteristic behaviour.

The band system at 3750 Å is assigned to $\pi^* \leftarrow n$ type of transition. This shows the characteristics of an allowed transition. The bands at 25943, 26694 and 26807 cm.$^{-1}$ have been fixed as *o,o* bands for *ortho*-, *meta*- and *para*-chlorobenzaldehydes respectively. The principal excited state frequencies involved in the spectra are 1324, 1316 and 1344 cm.$^{-1}$ in the *o*-, *m*- and *p*-chlorobenzaldehydes. These have been shown to be due to C = O stretching in the excited state.

The shifts in the transition energies of the longest wavelength $\pi^* \leftarrow \pi$ system in the *o*-, *m*- and *p*-isomers are 1733, 1410 and 104 cm.$^{-1}$ respectively as compared to benzaldehyde. The order of the shift is thus $o > m > p$. This order is not consistent with that expected ($p > m > o$) on the basis of theoretical calculations specially of Sklar[7] and Förster.[8] The analysis of the substituent effect by Goodman and Shull,[9] however, explains the order of shift observed in the present case.

The order of the shift in $\pi^* \leftarrow n$ transition is also $o > m > p$.[10]

The analysis proposed by Garg[2] shows that 400 cm.$^{-1}$ is by far the most prominent excited state frequency involved in the benzaldehyde spectrum. There are however certain inconsistencies in analysis as proposed by him and hence it has been revised. Two more excited state fundamentals, *viz.*, 798 and 1208 cm.$^{-1}$ have been selected in addition to other fundamentals already identified by Garg.

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June 1, 1960.

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** Axes of co-ordinates as per recommendations of Joint Commission of Spectroscopy.[11]

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CARVONE ANALYSIS BY ULTRA-VIOLET ABSORPTION IN INDIAN DILL OILS (*ANETHUM SOWA*)

Oil from dill seeds contains limonene, carvone and dillapiol as the main constituents and is used for the flavouring of many kinds of food products and in the preparation of pharmaceutics. The carvone content in dill oils is of industrial importance and it has been estimated in some Indian dill seed oils spectrophotometrically.

Carvone shows two absorption maxima, 320 mμ and 235 mμ.[1] Reitsema and Faas[2] estimated carvone spectrophotometrically in spearmint oils containing more than 60% of carvone. The absorption measurements were carried out at 320 mμ as it required a small amount of the solvent (15 ml.). The results they obtained were in good agreement with those obtained by neutral sodium sulphite method.[3] The present work is an extension of the carvone estimation in the range *to lower limits* of 10 to 60% (V/V).

A calibration chart of carvone was prepared by noting the absorbance of solutions of various concentrations in methyl alcohol (Fig. 1,

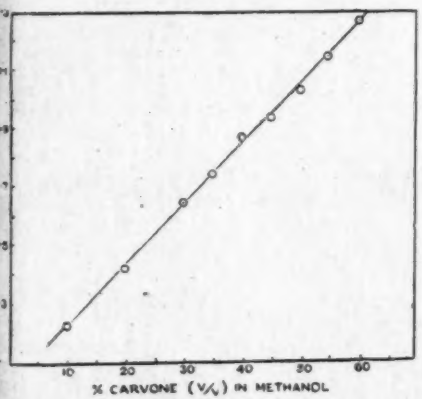

FIG. 1

Table I). The carvone content of the particular oil was obtained from this calibration chart corresponding to its absorbance. The percentage found by analysis was in all cases within 1% of the values obtained by hydroxylamine hydrochloride (B.P. method,[4] Table II). The data of the Tables I and II are based upon the

TABLE I

Absorbance of carvone in methanol

Carvone % (V/V)	Absorbance	Carvone % found (Hydroxylamine hydrochloride method)
10	0·227	10·2
20	0·420	20·32
30	0·650	29·76
35	0·750	35·38
40	0·870	39·82
45	0·941	45·12
50	1·03	50·24
55	1·15	54·73
60	1·27	60·49

TABLE II

% Carvone, specific rotation, refractive index of dill seed oil samples

Sample No.	% Carvone (V/V) Spectrophotometrically	% Carvone (V/V) $NH_2OH \cdot HCl$ method	$\alpha^{30°}_{Na_D}$	$n^{30°}$
1	43·5	44·0	44·0	1·4932
2	47·0	46·44	32·8	1·4945
3	41·0	41·40	52·8	1·4867
4	48·75	48·24	40·2	1·4920
5	41·80	42·10	50·4	1·4860
Carvone sample	..	99·62 (by weight)	59·34	1·4948

solutions prepared on a volume basis in the usual way of the industry.

EXPERIMENTAL

A boiling fraction (225–235°) of dill seed oil was treated with neutral solution of sodium sulphite and the aqueous layer was treated with sodium hydroxide. The liberated carvone was steam-distilled and subjected to fractionation under reduced pressure. The fraction, b.p. 95–96° at 8 mm. pressure was collected as pure sample of carvone.[5]

A sample of 0·1 ml. of dill oil or carvone containing solution was measured with a micropipette and was diluted to 15 ml. with spectroscopically pure methanol. Absorbance of the solution at 320 mμ was read with a DU Beckman Spectrophotometer keeping the slit width constant. From the standard chart (Fig. 1), the percentages of carvone in the samples were determined.

Carvone content in all the solutions and in dill oil samples was determined by hydroxylamine hydrochloride. 1 ml. of the carvone solution or dill oil was treated with 10 ml. N hydroxylamine hydrochloride solution (alcoholic) and the acid liberated was titrated with standard alcoholic potassium hydroxide using dimethyl yellow as indicator.

Acknowledgement is made to Shri G. N. Gupta, H.B. Technological Institute, Kanpur, for providing the samples of dill seed oils and to Dr. R. H. Sahasrabudhey for facilities.

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SYNTHESIS OF COUMARYL-THIOUREAS

MANY coumarins are found to be physiologically active as narcotics, sedatives and hypnotics.[1] Thioureas also show a wide variety of physiological activity.[2] Substituted benzyl thioureas are found to be active against *Staphylococcus citrus, Staph. albus, Staph. aureus* and *Bucillus subtilis* as well as *Typhus*.[3] It was of interest to synthesize compounds containing thioureido and coumaryl moiety with a view to studying their physiological activity. Compounds described in Table I have been prepared and their physiological testings are under investigation.

Coumarin was nitrated and reduced to get 6-aminocoumarin according to Morgan and Micklethwait.[4] The reactions of amino group in the benzenoid ring of coumarin are normal. They give isocyanate and isothiocyanate.[5]

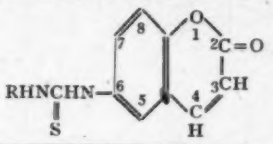
The substituted isothiocyanates were prepared from the corresponding amines according to Shah, Trivedi and Trivedi.[6] Benzoyl isothiocynate was prepared from benzoyl chloride.[7] The 6-aminocoumarin was condensed with the isothiocyanates according to Buu-Hoi *et al.*[8] Table I describes the N'-(6-Coumaryl)-N-(Substituted) thioureas.

All melting-points are uncorrected.

Authors thank Drs. N. M. Shah and J. J. Trivedi for their interest in this work.

TABLE I

N'-(6-Coumaryl)-N-(Substituted) Thioureas



No.	R=	M.P.	Analysis S= Theoretical	Analysis S= Found
1	C_6H_5	168°	Reference no. 5	
2	$C_6H_4CH_3$ (*p*)	134–35°	10·3	10·2
3	C_6H_4Cl (*o*)	170°	9·7	9·7
4	C_6H_4Cl (*m*)	245° (*d*)	9·7	9·5
5	$C_6H_4OCH_3$ (*o*)	112°	9·8	9·7
6	$C_6H_4OC_4H_9$ (*n, p*)	135°	8·7	8·7
7	$C_6H_4OC_6H_{13}$ (*n. p*)	111°	8·1	8·1
8	$C_6H_5CH(CH_3)$	160°	9·9	9·8
9	C_6H_5CO	190°	9·6	9·6
10	$C_6H_5CH_2$	185–86°	10·3	10·2
11	$ClC_6H_4CH_2$ (*o*)	200°	9·2	9·0
12	$ClC_6H_4CH_2$ (*p*)	216°	9·2	9·1
13	$BrC_6H_4CH_2$ (*o*)	160°	8·2	8·1
14	$BrC_6H_4CH_2$ (*p*)	196°	8·2	8·2
15	$CH_3C_6H_4CH_2$ (*m*)	174°	9·8	9·6
16	$(CH_3)_2C_6H_3CH_2$ (2, 4)	190°	9·5	9·4
17	$(CH_3)_2C_6H_3CH_2$ (2, 5)	188°	9·5	9·4

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TAPIOCA AS A SOURCE OF ALCOHOL

TAPIOCA, also called cassava or manioc (*Manihot utilissima*), which occurs in tubers, has been widely mentioned as a source of alcohol. The tubers are stated to contain 25% starch and about 5% fermentable sugars,[1,2] and their average yield per acre is given as about 10 tons,[2,3] approximately equivalent to 5,000 lb. of extractable starch.

As a raw material for alcohol, tapioca was taken cognizance of at the Seminar held in

Lucknow in 1952 on "the Production and Use of Power Alcohol in Asia and the Far East". No particulars are however available of the processing of tapioca for fermentation.

Tapioca has been a prominent and extensive crop in Travancore. At one time when ethyl alcohol was being experimentally tried in Travancore as motor fuel in the transport buses, it was examined how tapioca, an indigenous raw material, could be utilized to supplement molasses for the production of alcohol. The following experiments were then undertaken.

Saccharification

Tapioca being a starchy material, the first step in producing alcohol from it is the conversion of its starch into sugar. How easily and satisfactorily this process of hydrolysis, called saccharification, could be effected had therefore to be examined. The tubers were cut into pieces, and weighed amounts, ½ lb. or ⅜ lb. of the pieces were put in glass flasks, treated with water in the proportion of 1,000 c.c. per lb. and, after the addition of varying proportions of sulphuric acid, were heated at atmospheric pressure or at higher pressures for stated periods. The heating of the flasks under pressure was carried out inside a vertical boiler intended for raising steam for working the distillery pumps. The flasks were accommodated inside the boiler quite above the water-level, and the boiler was started and maintained at the desired pressures for definite periods of time.

The details of the saccharification trials are shown in Table I.

It will be seen that more or less optimum conditions for the saccharification were obtained when tapioca was heated with 2·5% of its weight of sulphuric acid at 15-20 lb. pressure per square inch for 5-7 hours (*vide* Expts. 3 and 4). Lower proportions of acid employed at this pressure brought about incomplete saccharification. At the end of a saccharification a second charge of tapioca could not be successfully saccharified in the same acidic solution. For example, after the saccharification was completed in Expt. 4 *b*, the flask was taken out and reheated with a further equal addition of tapioca to its contents, at the same pressure and for the same period as before but without any more acid. The increase in sugar due to the second addition of tapioca was only 12·7% on its weight (*vide* Expt. 4 *c*). It is thus clear that hydrolysis involved consumption of acid and only a partial charge might have been fully saccharified in the reheating.

At a high pressure of 50-60 lb. per square inch, heating the tapioca for 4 hours with 2% sulphuric acid on its weight gave a dark solution with a burnt smell (*vide* Expt. 5 *a*). At the same pressure 1·5% acid gave a high yield of sugar (*vide* Expts. 5 *b* and 5 *c*), but yet showed a tendency to produce a dark or burnt solution.

Table I

Saccharification of tapioca and alcohol yields

Expt. No.	Wt. of tapioca lb.	% conc. sulph. acid by wt. on tapioca	Method of heating and lb. pressure per square inch	Hours of heating	% reducing sugar as glucose on tapioca obtained	Net c.c. abs. alc. from the wt. of tapioca fermented	Gallons of abs. alcohol per ton of tapioca	Remarks
1	½	3·2	Heated in steam steriliser at atmospheric pressure	6	33·9	32·65	32·2	..
2 (*a*)	½	3·2	15–20	4	36·0	39·55	39·1	..
(*b*)	½	1·6	15–20	4	18·2	..	..	..
3 (*a*)	½	2·5	15–20	7	35·9	37·15	36·7	..
(*b*)	½	2·0	15–20	7	32·0	31·28	30·8	..
(*c*)	½	1·5	15–20	7	22·3	..	..	..
4 (*a*)	½	2·5	15–20	5	37·7	..	..	..
(*b*)	½	2·5	15–20	5	38·1	..	..	..
(*c*)	½	see text	15–20	5	12·7	..	..	..
5 (*a*)	½	2·0	50–60	4	27·1*	..	..	*dark soln.
(*b*)	½	1·5	50–60	4	33·8	25·85	34·0	..
(*c*)	½	1·5	50–60	4	35·6	29·68	39·1	..
6 (*a*)	½	0·5	50–60	4	6·8	..	..	..
(*b*)	½	1·0	50–60	4	19·8	..	..	..
(*c*)	½	1·5	50–60	4	27·8	..	..	..

N.B.:—In each experiment water was used in the proportion of 1,000 c.c. per lb. of tapioca. The experiments under each num eral were done simultaneously in a batch.

Hydrolysis with lower proportions of sulphuric acid, namely, 0·5% and 1·0%, at that high pressure did not conduce to thorough saccharification (*vide* Expts. 6 *a* and 6 *b*), in spite of preheating the tapioca in these cases with water for two hours at the same high pressure.

At the ordinary atmospheric pressure the saccharification seemed to require over 3% sulphuric acid and prolonged heating of over 6 hours (*vide* Expt. 1).

SUGAR ESTIMATION AND FERMENTATION

After completing the saccharification, the solution was neutralised with calcium carbonate, strained, cooled and made up to a definite volume and an aliquot portion, suitably diluted, was titrated with Fehling's solution. The sugar thus estimated under the optimum conditions of saccharification amounted to 36-38% as glucose on the tapioca examined.

The saccharified solution, neutralised and cooled, was in some experiments (*vide* Table I) inoculated with a pure culture of distillery yeast. At the end of the fermentation the alcohol was distilled and, after due allowance for the alcohol in the inoculant, was expressed in terms of gallons of absolute alcohol per ton of tapioca, the best yield being 39 gallons per ton. On the practical scale an average yield of 35 gallons of absolute alcohol per ton of tapioca may be estimated to be possible.

Being a food material which is now being processed into synthetic rice, sago, etc., and a source of industrial starch, tapioca cannot in normal times economically compete with molasses as a raw-material for alcohol.

The author records his thanks to Messrs. Parry & Co., Ltd., for the opportunity of carrying out the experiments referred to.

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CHEMICAL PULP FROM MESTA STICK

IT has been reported[1] earlier that by employing suitable conditions of digestions, chemical pulp (soda and sulphate) of satisfactory yield and strength characteristics can be prepared from jute sticks. Mesta fibres are an important substitute to jute fibres. The stick contains about 78·6% holocellulose, 37·7% alpho cellulose, 20·30% lignin and 0·6% ash. The chemical analysis of mesta sticks shows that they are almost identical with jute sticks[2]; hence, investigation were undertaken to compare the pulping characteristics of mesta sticks with those of jute sticks.

Several digestions of mesta stick chips using soda process were carried out at 153° C. The strengths of cooking liquors were varied between 3·0 and 4·0% caustic soda solutions, and digestion periods were varied between 3·0 and 5·0 hours. The optimum results were obtained with 3·4–3·5% alkali solution and 4·0 hours cooking period at the maximum cooking temperature. The yields of unbleached and bleached pulps were about 46·5 and 42·4% respectively on oven-dry basis of the raw material. The alkali consumptions and chlorine demands were about 24% (NaOH) and 4·4% (available Cl_2) respectively on oven-dry raw material.

Pulps were beaten in laboratory beater and hand-sheets of about 60 gm./m.^{2} were made on vicovat. The sheets were dried in air on metal plates. Sheets were conditioned at 65% R.H. and 80° ± 2° F., and conditioned sheets were tested for burst and tensile strengths. The burst factor and the breaking length for best unbleached sheets were 16 and about 3,700 metres respectively; the corresponding figures for bleached sheets were 15 and 3,600 metres. Thus there was practically no difference in strength characteristics of unbleached and bleached pulp sheets.

Comparing the pulping characteristics of mesta stick with those of jute stick, we find:

(i) The chemical composition, pulp yields, fibre dimensions, alkali consumptions and chlorine demand are almost identical in both cases.

(ii) The unbleached pulp from mesta stick is lighter in shade while the bleached pulp is brighter as compared with those of jute stick pulps.

(iii) The pulp from mesta sticks has very poor drainage and hence considerable difficulties were experienced in washing and sheet-making.

(iv) The paper produced from mesta stick pulps are fluffy by nature.

(v) The strength characteristics of both the unbleached and the bleached pulps from mesta sticks are much lower than those from jute sticks as shown in Table I.

TABLE I

	Unbleached		Bleached	
	Jute Stick	Mesta Stick	Jute Stick	Mesta Stick
Burst Factor (Mullen)	50	16	28	15
Breaking Length (Metres)	9000	3700	6000	3600

From the above investigations it may be concluded that although jute sticks and mesta sticks are alike as far as pulp yields and chemical composition are concerned the pulp from mesta sticks are much inferior to jute stick pulps as far as strength characteristics, physical and operational conditions are concerned.

Thanks are due to Dr. P. B. Sarkar, Director, for his keen interest and valuable suggestions.

Technological Res. Labs., S. C. JAIN.*
12, Regent Park, K. K. BHOWMICK.
Calcutta-40, *April* 18, 1960.

* Present address: Sirpur Paper Mills Ltd., Sirpur, Kagaznagar.

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COPPER CHLOROPHYLL AS A COLOURING AGENT FOR HYDROGENATED VEGETABLE OIL (H.V.O.)

As the present addition of sesame oil (5%) to H.V.O. does not provide a visual means of detecting adulteration of ghee, there is a great public demand for the coloration of H.V.O. Even the addition of a colour cannot provide a full safeguard against adulteration, as any extrinsic colouring matter will be removed by treatment with bleaching agents like activated charcoal/Fuller's earth.

Advantage can, however, be taken of the distinctive properties of both 5% sesame oil and a colouring matter and it is therefore suggested that the addition of a colour to H.V.O. *already containing* 5% sesame oil be adopted so that one supplements the other. Such a course seems to provide a good enough solution to eliminate a major part of the fraudulent practice of adulterating ghee with H.V.O.

Since natural ghee is generally associated with a creamy-yellow colour, it seems unlikely that yellow can be of value in solving this problem. Green seems to offer a possible choice for consideration.

As far back as 1949, chlorophyll was suggested by Dr. R. S. Thakur, then Scientific Adviser to Master-General of Ordnance, as a suitable colour for H.V.O. and later by Puntambekar and Ramachandra Rao (*Current Science*, 1951, 20, 68). This was, however, not accepted, as the colour is removed by bleaching.

In view of this, preliminary experiments have been carried out with a commercial grade of copper chlorophyll or more correctly copper phæophytin, a copper derivative of chlorophyll —which has an intense green colour and unlike chlorophyll itself, has great stability and fastness to light—to find out how far this colouring agent meets the requirements prescribed for a suitable colouring matter for use in hydrogenated vegetable oil.

Results of experiments show that:—

(*a*) Copper chlorophyll is easily soluble in H.V.O. and has a bluish-green shade, pleasing to the eye. A colour concentration of 0·05% (50 mg. in 100 c.c. of H.V.O.) appears to be suitable for colouring and at this concentration it is easy to detect adulteration visually at 10% level.

(*b*) It is not removed by
- (*i*) heating alone or in presence of moisture. The colour does not decompose when heated for 2 hrs. at about 200° C.;
- (*ii*) prolonged exposure to sunlight;
- (*iii*) treatment with acids and washing soda;
- (*iv*) ordinary charcoal—either coarse grains or fine.

(*c*) It is, however, removed by
- (*i*) activated vegetable charcoal;
- (*ii*) Fuller's earth.

(*d*) It affects neither taste nor flavour of H.V.O.

(*e*) Baudouin test—The presence of copper chlorophyll does not interfere with Baudouin test for sesame oil. The coloured oil after bleaching by activated vegetable charcoal/Fuller's earth shows reduction in intensity of Baudouin colour when tested for sesame oil. In this respect, it will be noted that H.V.O. itself when treated with bleaching agents also behaves similarly, *i.e.*, shows considerably reduced Baudouin colour.

It will be seen from the above results that copper chlorophyll bids fair to be a satisfactory colouring agent for the purpose.

Further work is planned, particularly in respect of:—

(*a*) Toxicological effects of copper chlorophyll, if any. (The permissible limit of copper in food under 'The Prevention of Food Adulteration Rules, India,' is 30 p.p.m. The copper content in H.V.O. containing 0·05% copper chlorophyll will not be more than 5 p.p.m. and that too as non-ionic).

(*b*) Effect of copper chlorophyll on keeping quality of the coloured product.

My grateful thanks are due to Professor D. S. Kothari, Scientific Adviser to Minister of

Defence, for his very keen and kind interest and encouragement in this work and permission to publish this note.

Research and Development Organisation, Ministry of Defence, New Delhi, *July* 20, 1960. K. B. GHOSE.

SURVIVAL OF RHIZOBIA IN INOCULATED SEED

AN estimate of the loss in viability of rhizobia in inoculated seed is of considerable practical importance especially when a time interval between inoculation and sowing is inevitable and where sale of the inoculated seed itself is in vogue. Experiments were carried out to determine the loss in viability on Subterranean Clover seed inoculated with a peat-based legume inoculant (later mixed with rye grass seed) and stored in cloth bags at room temperature (min. 40° F., max. 70° F.). Two methods of seed inoculation were compared, *viz.*, (A) addition of sufficient water to wet the seed during mixing of the seed and the inoculant, and (B) addition of thin sucrose solution in place of water. The loss in viability was determined in all cases and the average logarithmic decline of rhizobia was expressed on the lines described earlier,[2] the time interval in the present study being of three days duration. The data are presented in Table I.

TABLE I

Time interval in days	*Viable counts of rhizobia per g. of seed ($\times 10^3$)	
	(A) Inoculation using water	(B) Inoculation using sugar solution
0	70	70
3	40	80
6	30	130
9	10	120
12	20	100
Average logarithmic decline 'K'	−0·1690	+0·0486
1/K	5·91	

* Each value is an average of three plate counts.

As seen from the data the viable counts in (B), though insignificant, registered an increase up to six days, and thereafter the decline commenced. The influence of moisture to maintain viability is well known.[3] Clark[1] has claimed that the quantity of the inoculant required for dry inoculation (without use of water) of a pound of soyabean seed would be satisfactory for five pounds of seed if water is used. It is suggestive from the data presented here that sucrose solution serves as an energy material for the rhizobia and thereby helps increase their numbers. It would therefore seem desirable to use sucrose solution in legume seed inoculation.

Details will be published elsewhere.

My sincere thanks are due to Dr. I. D. Blair, Head of the Department of Microbiology, Canterbury Agricultural College, Christchurch (New Zealand), under whose guidance the above work was carried out. I wish to express my gratitude to the Government of New Zealand for the award of a Fellowship under the Colombo Plan, which enabled me to carry out the studies reported.

April 18, 1960. A. SANKARAM.*

* Agricultural Bacteriologist, Government of Andhra Pradesh (on leave). Now at: Division of Chemistry, I.A.R.I., New Delhi-12.

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COLOURING OF VANASPATI WITH CURCUMIN FROM TURMERIC

THE problem of detecting adulteration of ghee with vanaspati through addition of a visible colour has not yet met with success because of the stringent conditions that have been laid down for the colour. Previous work from this Institute relates to addition of latent colour like phenolphthalein[1] and the simplification of the Baudouin test[2] for use by the lay public. Several other latent and visible colours have also been suggested.[3,4] Recently, addition of vitamin K and its derivative[5] have been suggested as possible colouring agents for vanaspati. Mukerji and co-workers[6] made a detailed study of the use of various synthetic and vegetable colouring agents and reported that the dye from the Ratanjot root was found to be somewhat more promising than all the other colouring agents. At the same time it has been realized that long-term feeding experiments have to be conducted before a categorical statement can be made about its nontoxicity, especially since it has been reported to be responsible for the fatty degeneration of the liver.[7]

Turmeric has already been suggested by several people because it is absolutely safe and already in use as an article of food. We have recently examined the possibility of using colouring matter extracted from turmeric which has not

so far been given an adequate trial mainly on the grounds that vanaspati so coloured (yellow) will resemble cow ghee in appearance. But this argument wears thin because on adding, to the suspected sample, lime which is available in every Indian home turmeric colour turns red and will reveal itself. Even at a 10% level of vanaspati in ghee the test is positive. The colour is not soluble in water and so vanaspati added to milk, made to curds and churned goes with the butter and colours it. Preliminary studies on the effect of frying *puris, pappadam*, eggs in this coloured vanaspati have shown that the colour is not much affected at the frying temperature. The fried fat in addition develops a rancid odour, which is still carried forward when added to curd and churned to separate the adulterated butter. Such a product, after melting, can be easily spotted by the consumer.

Instead of using turmeric as such, we have used curcumin obtained as a crude extract mixed with the oil of turmeric on extracting the powdered turmeric with alcohol. The crude extract amounts to 7-8% on the weight of the dry powder. Addition of this to vanaspati at 0·04% on the weight of the fat is considered an optimum level. At this level vanaspati acquires a pleasant acceptable colour and when it is added even at 10% level to ghee, the colour is clearly visible and responds to the lime test.

Cost

Taking the present market price of turmeric in bulk at Rs. 48 per maund (80 lb.) and reckoning the yield of crude curcumin at 8%, the cost of colourization per pound of vanaspati inclusive of the extraction process, comes to less than 1 nP. only. On the basis of average production of vanaspati in the country at 4 lakh tons, we will need 2,000 tons of turmeric which represents about 1% of total production of turmeric in the country.

The addition of turmeric colour (at 0·04% level of the extract) will serve as a deterrent for the adulteration of ghee with vanaspati because it acts both as a visible and as a latent colour.

It is considered desirable that the addition of sesame oil should also be continued as it will serve as an additional check through the Baudouin test. This is not affected by the presence of the turmeric colour in the concentration that has been recommended.

Central Food Technological Research Institute, Mysore, *September* 5, 1960.

O. P. Kapur.
M. Srinivasan.
V. Subrahmanyan.

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ALLYL SULPHIDE CONTENT OF GARLIC

The pungency, the strong flavour,[1] and the keeping quality[2] of garlic (*Allium sativum*) and onion (*Allium cepa*) are found to be associated with the content of volatile sulphur, which in the essential oil of garlic and onion is found chiefly as the compound, allyl sulphide.[3,4]

An investigation into the effect of various nutritional elements, both major and minor in different doses, on the allyl sulphide content and other characters of garlic sown under different spacings, was undertaken at the College (Agriculture) Experimental Farm in 1954-55. The allyl sulphide content in the garlic bulb under the main effect treatments* is analysed and given below :

Treatment and Lay-out

A. Macro-elements mixture (N + P + K) was applied in 3 doses : (per acre basis).
   M_0 = no manure ;
   M_1 = 50 lb. of the mixture to supply : N = 39 lb. as ammonium sulphate. P = 4·5 lb. as superphosphate ; K = 6·5 lb. as potassium sulphate.
   N_2 = 75 lb. of the mixture to supply : N = 58·5 lb. as ammonium sulphate ; P = 6·75 lb. as superphosphate ; K = 9·75 lb. as potassium sulphate.

B. Micro-elements mixture (B + Zn + B_0) was applied in 3 doses : (per acre basis).
   E_0 = no manure ;
   E_1 = 4·99 lb. of the mixture to supply : B = 0·74 lb. as borax ; Zn = 4·01 lb. as zinc oxide ; N_0 = 0·24 lb. as ammonium molybdate.
   E_2 = 7·48 lb. of the mixture to supply : B = 1·11 lb. as borax ; 6·01 lb. as zinc oxide ; M_0 = 0·36 lb. as ammonium molybdate.

* The average differences among the different doses of macro-elements mixture (M), micro-elements mixture (E), and different spacings (S).

C. Spacing (3 distances between rows): $S_1 = 3''$; $S_2 = 5''$; $S_3 = 7''$; distance between plants in the row was 4" in all the cases.

Thus the total number of treatments were 9 with 3 replications, and the plots of 17' × 13' size were laid out in a randomized block design. The manure was applied on the 31st October 1954, after the soil (sandy loam in character and kept fallow during rainy season) was brought to a level of appropriate tilth on repeated ploughings. A local high yielding variety was sown on the 1st November 1954 and was harvested on the 5th April 1955.

At the maturity of the plant (150 days) samples were collected, chopped into pieces and 10 gm. of each treatment were preserved in absolute alcohol separately in glass-stoppered bottles for the estimation of allyl sulphide. The stored alcoholic extract was filtered and the filtrate was made to volume in a 50 c.c. volumetric flask with 80% ethyl alcohol at the time of the estimation of the allyl sulphide. A 5 c.c. sample, equivalent to 1 g. of the material, was taken and cleared by saturated lead acetate and the excess of lead was removed by sodium oxalate. The sample was cooled in cold water for 3 minutes and the clear extract was poured off. 5 c.c. of the 80% alcohol and 10 c.c. of gold chloride (1 : 1000) was subsequently added to the clarified extract. The mixture was allowed to stand for 10 minutes when the turbidity was determined by measuring the percentage transmission with the aid of a Gallenkamp direct reading photo-electric colorimeter. The concentration of allyl sulphide was determined by comparing the above values with the transmission values of standard allyl sulphide solution treated in the manner described in the plant sample.[5] All the readings were converted to milligram per gram of the plant material and the results are given in Table I.

From the results shown in Table I it can be concluded that 75 lb. of macro-elements mixture (N + P + K), and 4·99 lb. of micro-elements mixture (B + Zn + M_0) with 5" distance between rows (and 4" distance between plants) give the maximum concentration of allyl sulphide in the garlic bulb under the condition stated above.

The work was carried out under the guidance of Dr. J. R. Singh, College of Agriculture, Banaras Hindu University, to whom the author wishes to record his thanks.

Post-Graduate Basic Training College, Agartala (Tripura), *May* 23, 1960.

S. K. Choudhury.

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A NEW SPECIES OF *NIGROSPORA* ZIMM. ON *ORYZA SATIVA* L.

Blackening of the ears of paddy may be caused by several factors including fungi. Lately this has been observed to be due to an unrecorded species of *Nigrospora*, in certain districts of Rajasthan (Banswara, Dungarpur and Dholpur) which is described in this note.

The species of the genus *Nigrospora* are distinguishable only through the morphological characters of their spores.[2] On paddy, three species of *Nigrospora*, *viz.*, *N. oryzæ* (B. and Br.) Petch., *N. sphærica* (Sacc.) Mason and *N. panici* Zimm. have been reported.[1-3] Examination of the diseased material collected from Dholpur revealed the presence of a *Nigrospora* species

Table I

Allyl sulphide content in garlic bulb under the different doses and spacings of the main effect treatments—M, E, S

	Treatments						Spacings (row to row)		
	Macro-elements mixture (in lb.)			Micro-elements mixture (in lb.)					
	M_0 nil	M_1 50	M_2 75	E_0 nil	E_1 4·99	E_2 7·48	S_1 3"	S_2 5"	S_3 7"
Allyl Sulphide (mg./g.) ..	7·40	8·50	10·00	7·25	9·90	7·50	2·50	11·00	7·60

which was morphologically different (having larger and globose to spherical spores) from those described earlier. It is, therefore, considered a distinct new species and proposed to be named as *Nigrospora padwickii* in honour of Dr. G. W. Padwick, a veteran scientist who has made valuable contributions on the diseases of paddy.

Sincere thanks are due to Shri Samarth Raj, Director of Agriculture, for facilities and to Rev. Father Dr. H. Santapau, Bombay, for the Latin description.

Plant Pathology Section, Department of Agriculture, Udaipur (Rajasthan), *May* 16, 1960.

N. PRASAD.
J. P. AGNIHOTRI.
J. P. AGARWAL.

Comparison of the size and shape of conidia of Nigrospora sp. *recorded on paddy*

S. No.	Pathogen	Size of the spores in μ			Shape of the conidia	Authority
		Length	Breadth	Average		
1	*N. oryzæ* ..	13·3–18·3	12·4–16·6	13·6×15·0	Spherical or sub-spherical	*Vaheeduddin, 1940
2	do. ..	13·8–17·9	12·4–17·9	15·0×15·3	Spherical	*Padwick, 1945
3	do. ..	13·2–15·8	11·9–15·8	13·6×15·0	Spherical or sub-spherical	do.
4	*N. sphærica* ..	..	..	16·0×18·0	Perfectly globose	Mason, 1927
5	*N. panici* ..	25·0–30·0	22·0–25·0	..	Globose and flattened	*Zimmermann, 1902
6	*Nigrospora* under study	33·5–41·8	31·8–40·2	37·94×34·82	Globose to spherical	Authors

* less quoted from Padwick, 1950

Nigrospora padwickii Prasad, Agni. and Agar. spec. nov.—Mycelia pallide brunnea, hyalina sub sultura; conidiophori fusce brunnei, breves (15–35 μ longi), extrusi ex stomatibus sporodochii more, tumescentes infra apicem; conidia fusca, levia, unicellulata, apicaliter et singulariter insidentia, globosa vel sphærica, magnit 37·94 μ × 34·82 μ diam.

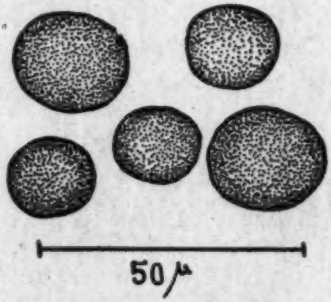

FIG. 1. *N. padwickii*—conidia.

Typus lectus in spicis viventibus *Oryzæ sativæ* L., die 30 septembris ad Dholpur, in Rajasthan a J. P. Agarwal et positus in I.M.I. in hortu Kewensi, in Anglia et in Herb. Crypt. Ind. Orient. I.A.R.I., New Delhi:

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VARIETAL RESISTANCE OF WHEAT TO LOOSE SMUT IN UTTAR PRADESH

Loose smut of wheat [*Ustilago tritici* (Pers.) Rostrup.] causes losses up to 30% in Uttar Pradesh during unfavourable weather. The affected ears appear earlier than the healthy ones and are covered with a silvery membrane which soon bursts to release a black mass of spores. All grains of the affected ear are reduced to a black powder which is blown off by wind leaving the central floral axis behind. The infection is of the blossom type and the fungus remains dormant in the embryo at the time of seed formation. Fungicides applied to the superficial layers of the seed are ineffective and solar treatment could be effective only in plains during a short period of very hot and dry weather. Thus the use of resistant varieties by the cultivator is still the most effective means of controlling this disease.

Mehta *et al.*[1] tested a number of wheat varieties against loose smut in Uttar Pradesh by the Moore's partial vacuum method[2] and reported

a few varieties tolerant to this disease. These studies were continued with 26 more varieties for a further period of 5 years (1953-58). Infection ratings calculated on the basis of total percentage of loose smut affected ears are given below :—

Percentage of loose smut affected ears	Varieties
Resistant (Below 1%) ..	Bansi C.P.
Moderately resistant (1 to 5% infection)	Bansi Palli 808, Bansi 224, N.P. 710, N.P. 165, Pb 228, N.P. 770, N.P. 797, N.P. 798, N.P. 809, N.P. 721, E. 1046, Gaza and N.P. 799
Moderately susceptible (5 to 10% infection)	N.P. 758 and Ridley
Susceptible (10 to 25% infection)	Pb 281, K 53, N.P. 781 and K 49
Highly susceptible (infection over 25%)	Pb 9 D, Pb 591, N.P. 12, N.P. 771, K 57, and K 54

Laboratory of the Plant Pathologist to Govt., U.P., Kanpur,
April 23, 1960.

R. S. MATHUR.
S. C. ATHEYA.
S. C. MATHUR.
J. S. JAIN.

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A NEW FLUORESCENT LIGHT TRAP FOR THE COLLECTION OF BEETLES

ATTRACTION of insects to light, particularly during rains, is a very well-known phenomenon. Some of the major sugarcane pests also show a high degree of phototropism in their winged stage. The beetle *Lachnosterna consanguinea* Blanch, a serious pest of the sugarcane crop in Bihar, has been observed to rush to light in great numbers immediately after emergence, with the commencement of monsoon rains. The trapping of the beetles at the light points has, therefore, been considered as one of the easy and practical ways of their destruction. Preliminary observations with (i) globe petromax, 200 C.P. (Rothamstead light trap); (ii) ordinary electric bulb 200 watts and (iii) fluorescent tube light revealed the superiority of the last source in attracting insects. Accordingly a fluorescent light trap has been designed in the Entomological Laboratories of the Indian Institute of Sugarcane Research, Lucknow, the details of which are described in this note.

The fluorescent beetle trap (Fig. 1) consists of a 4 ft. 40 W. fluorescent tube fixed 4'–4" above the longitudinal centre line of a collector funnel having a rectangular open top 4'–4" × 8" and a rectangular open bottom of 4'–4" × 6". This collector funnel is lined with polished aluminium sheet inside. Immediately below the collector funnel is a galvanised iron tray 4'–6" × 18" × 9" suspended from 4 hooks on an iron framework carrying the whole assembly. This trap is mounted on wooden posts in the field. Beetles attracted by the light and striking any part of the fluorescent tube or the sides of the collection funnel drop into the tray which contains kerosenised water and are killed. The tray when full can be easily unhooked and removed and a second tray inserted.

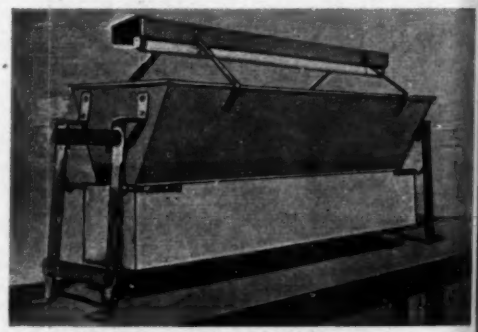

FIG. 1. The Fluorescent Light Trap.

To make a comparison of the efficiency of the ordinary and the new light trap a number of them were set up in different areas of the Farm of M/s. Rohtas Industries Ltd., Dalmianagar (Bihar), in July, 1958. The average number of beetles collected at each of the two traps per night is shown in Table I.

TABLE I

Date	Number of beetles collected	
	New trap fluorescent tubes	Ordinary trap 200 watts bulb
6—7—1958	1920	40
7—7—1958	1680	227
8—7—1958	1020	170
9—7—1953	950	68
12—7—1958	465	100
13—7—1958	1380	160
14—7—1958	780	167
15—7—1958	960	127

In actual working it was observed that no beetle fell outside the trap and hence no extra labour was required to attend to it during the night.

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THE CERVICAL VERTEBRAE OF A LORIS

WHILE studying the development and adult morphology of the vertebral column of the slender loris *Loris tardigradus lydekkerianus* Cabr., I came across a peculiar feature in the cervical region of a female skeleton. Generally the neck vertebræ number seven in mammals and in the loris cervical skeleton on which I am reporting (*see* Fig. 1), there is not only a reduction in the number to five but also a fusion of the last two (6th and 7th) vertebræ; the fifth appears to be absent. Normally the fifth vertebra has a shorter spine than the sixth and in the variant fused vertebra, I notice that the spine is more like that of the normal sixth. Rau and Sundaresan (1931) state in the summary that the spinous processes are absent in the cervical vertebræ except the second and the seventh but describe a 'real spine' in the sixth vertebra. I have noticed in the adult vertebral columns that I have examined, the spines are normally present. The fusion of the sixth and seventh vertebræ is complete ventrally while at the junction of the pedicles and laminæ of the neural arches, there is a clear groove; the transverse processes are fused completely. The partial fusion of the sixth and seventh vertebræ does not seem to be uncommon in loris as Mivart (1865) recorded in a foot-note that in loris "No. 67 *a* in the British Museum, the neural laminæ of the sixth and seventh cervical vertebræ are anchylosed together". The reduction in the number of cervical vertebrae from the normal seven to one or two below that has been noticed in a number of mammals; however, in a Gorilla skeleton the cervical vertebræ added one more to the usual number of seven (Bateson, 1894).

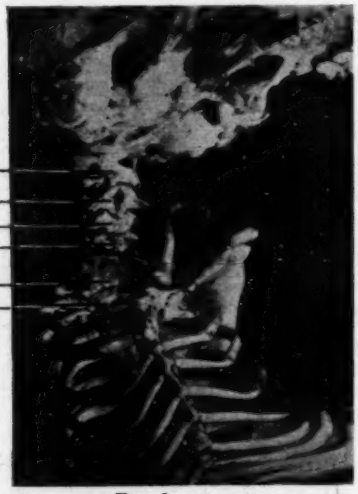

FIG. 1

Ventral view of a part of the skull, the cervical region and a part of the thoracic region of *Loris*, × 6 3/4.

c.v. 1–*c.v.* 4 : free cervical vertebræ 1–4.
c.v. 6+7 : fused cervical vertebræ 6 & 7.
th.v. 1 : first thoracic vertebræ with rib.

From a study of the development of the vertebral column of loris of a large series of sections, I do not find any indication of reduction of cartilaginous arches or the fusion of the same in any of them. Probably abnormalities are very rare and, therefore, it is difficult to study their meristic origin.

The development of the vertebral column of loris will be described elsewhere. I am indebted to Dr. L. S. Ramaswami for helpful guidance.

Dept. of Zoology, M. S. HANUMANTHA RAO.
Central College,
Bangalore, *August* 29, 1960.

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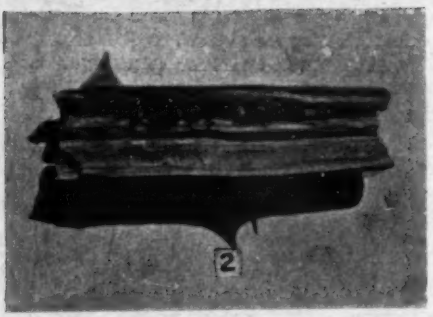
FIRST RECORD OF DIGGER WASP (*CRABRO* SP.) BURROWING INTO THE PITH OF CULTIVATED ROSE PLANTS

THE crabonidæ are a very distinct family of the digger wasps of world-wide distribution. Some of them nest in rotten wood in the deserted galleries of other insects, while a few species are known to burrow in the stems of cultivated hedge plants (Hamm and Richards, 1926). The adults especially the males are common visitors to flowers in gardens.

Recently a species of the genus *Crabro* of the Superfamily Sphecoidea, was noticed to do some damage to freshly pruned rose plants at the Indian Agricultural Research Institute. The wasps were found to burrow into the pith of rose stem through the cut-ends for nesting purpose (Fig. 1). The burrow is of the 'linear typus' described by Kohl (1915), the length ranging from 12 to 17 centimetres. The external opening of the burrow generally remains open but there is a stretch of empty tunnel leading from the nest to the external opening. A species of muscid fly is used by the digger wasp as prey; the paralysed flies are packed tightly in the linear burrow, the interspaces being

filled with wood particles (Fig. 2). About 10-15 flies are packed in about 2·5 centimetres of the burrow. The actual nest occupies about 6-9 centimetres of the burrow. The parasitic grub of the wasp has a prominent head and well-developed mandibles. It feeds on the paralysed fly by piercing the host integument with its sharp mandibles. The full-grown grub spins an yellowish-brown cocoon and pupates in the gallery. The pupal period lasted about 26 days under laboratory conditions.



FIGS. 1-2. Fig. 1. A pruned rose plant showing the external opening of the burrow made by the wasp (nat. size). Fig. 2. Rose stem split open to show the nest of the wasp packed with flies (nat. size).

It may be interesting to know how the digger wasp captures and disables the prey before it is dragged into the nest. The flies are apparently stung and paralysed by the wasp and carried into the gallery. The paralysed flies remained without decaying for over a month under laboratory conditions.

As a result of burrowing and nesting by the wasp, the tips of the pruned branches of rose plants were found to dry up. In many cases a fungus disease (die back—*Diplodia* sp.) had gained entry into the stem through the holes made by the wasp and as a result of which the whole branch sometimes dried up. It was found that some varieties of roses like the yellow, were apparently more susceptible to the attack, probably due to the large core of pith in the stem.

With a view to check the infection of the die back the cut-ends of the pruned branches used to be painted with a fungicide paint (copper carbonate, red lead and linseed oil) but this did not prevent the digger wasp from boring in. The fungicide paint was mixed with 0·1% DDT and 0·1% BHC and applied to the cut-ends, about a millimetre thick. The combined paint prevented the wasp burrowing into the stem through the cut-ends.

Our grateful thanks are due to Dr. B. P. Pal, Director, I.A.R.I., for drawing our attention to this insect and for his keen interest in this piece of work. Our thanks are also due to Dr. E. S. Narayanan, Head of the Division of Entomology, for the facilities.

Divn. of Entomology, I.A.R.I., New Delhi-12, *April* 16, 1960.

H. N. BATRA.
T. V. VENKATRAMAN
KISHEN KUMAR.

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FIELD TRIALS WITH SOME MODERN ORGANIC INSECTICIDES AGAINST TERMITE DAMAGE IN COTTON CROP

No attempt has so far been made to study the effect of modern organic insecticides on termite damage in cotton crop. With inorganic insecticides, Bedford[1] reported that the application of sawdust containing 1% paris green reduced losses of stand from 5 to 0·4% when applied @ 510 lb./acre. He further reported that this treatment was superior to naphthalene used @ 100-150 lb./acre. Hence, field trials with technical grades of different insecticides namely, DDT, BHC and dieldrin were conducted in plots measuring 1/54·5 of an acre for evaluating the efficacy of these insecticides. There were three dosages, namely, 5, 10 and 15 lb./acre of each insecticide. The source and form in which these insecticides were obtained have been reported in earlier publications on termite damage in wheat crop.[2,3] Each insecticide was applied in the furrows before sowing according to a randomised plan, there being no further insecticidal treatment during the entire season. The cotton variety (216 F) was sown @ 9 seers/acre. The number of germinated plants and those damaged by termites were counted in each plot

and the percentage of damage was calculated. The data together with the statistical analysis are presented in Table I.

TABLE I

Showing percentage of damaged cotton plants in different treatments

Insecticides	Dosage in lb./acre	Average percentage of damaged plants in four replications
DDT ..	5	8·06
" ..	10	4·04
" ..	15	2·87
BHC ..	5	6·49
" ..	10	2·66
" ..	15	2·22
Dieldrin ..	5	4·09
" ..	10	1·87
" ..	15	1·44
Control (Untreated)..	..	14·97

$S.E_m$ = ±1·16
C.D. at 5% = 3·36
C.D. at 1% = 4·35

It can be seen from Table I that the data on percentage damage of plants by termites showed highly significant differences at 1% level between the control and the treatments, the control showing the maximum percentage damage. The plots treated with dieldrin @ 15 lb./acre showed the least damage. The yield of cotton was also recorded but as there was no significant difference in various treatments, the same has not been included in the table. The insignificant differences in yield can be explained by the fact that along with termites, the cotton plants in the field are subjected to the ravages of all other pests, both sucking and chewing, which ultimately reduce the yield. Cotton crop unfortunately has got a host of such pests, *e.g.*, jassids, white flies, aphids, red cotton bug, cotton leaf-roller, spotted and pink bollworms and dusky cotton bug. As no other treatment was given to the standing plants except the one in the soil before sowing, all such external and internal pests interfered with the yield potential of the various treatments.

The authors are thankful to Dr. E. S. Narayanan, Head of the Division of Entomology, for his keen interest in the investigations. Thanks are also due to Dr. P. N. Saxena, Head of the Section of Statistics, for analysing the data and to the Indian Council of Agricultural Research for financing the Termite Research Scheme under which the present investigations were carried out.

Division of Entomology, Indian Agricultural Research Institute, New Delhi-12, *May* 10, 1960.

SNEHAMOY CHATTERJI.
PRAKASH SARUP.
S. C. CHOPRA.

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OCCURRENCE OF *COLLETOTRICHUM CURVATUM* BRIANT AND MARTYN ON *CROTALARIA JUNCEA* LINN. IN MYSORE

DURING the course of study of several varieties of *Crotalaria juncea* Linn. the authors noticed wilting of plants at the Agricultural Research Station, Hebbal, Bangalore. Detailed examination revealed that this was due to a fungus attack.

The characteristic symptom noticed was that the infected seedlings as well as adult plants showed wilting. However, Mitra (1937) reported that mostly the plants were affected at the seedling stage. The cotyledons as well as the leaves also were found to droop from petiole region. In the later stages, brown to dark-brown necrotic areas on the stem were clearly noticed at the collar region just above the ground-level. On closer examination of these necrotic areas, fruiting bodies of the fungus were observed.

Wilting in *Crotalaria juncea* has been reported to be due to *Fusarium vasinfectum* Atk. by Uppal and Kulkarni (1937) and as also due to *Colletotrichum curvatum* by Mitra (1937). Both these fungi were reported from India. In the present instance the fungus was identified as *C. curvatum*. The acervuli were found in abundance on the epidermis of the diseased region. They were hyaline or faintly pinkish in colour and consisted of simple, erect, closely compact conidiophores as well as setæ. The conidia were found in large numbers. They were one-celled, hyaline, falcate and measured 17·1–26·9 × 2·8–3·5 μ with an average of 23·3 μ long and 2·9 μ broad. The setæ which were observed in the acervuli were dark-brown in colour, septate, slightly swollen at the base and taper towards the tip to a sub-acute point. They were found between the conidiophores and measured 45–180 × 2·8-4·2 μ, with an average of 91·5 μ long and 3·5 μ broad.

Monosporic isolations were made in the laboratory and the fungus grew readily at room temperature on Potato-dextrose-agar. The

mycelial growth was very rapid and sporulation was observed on the 7th day after incubation. The setæ however were not observed in the culture media.

Further studies on the physiology of the fungus and pathogenicity studies in relation to different varieties of *Crotalaria juncea* is under progress.

The authors wish to thank Shri B. Venkoba Rao, Principal, for providing facilities.

Agricultural College, Hebbal, Bangalore-6, *April* 8, 1960.

C. KEMPANNA.
R. C. YARAGUNTAIAH.
H. C. GOVINDU.

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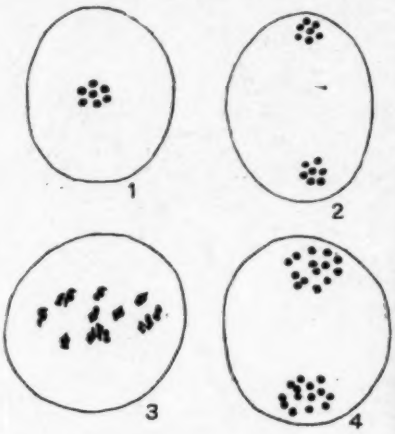
NATURALLY OCCURRING TETRAPLOIDY IN *NONNEA PULLA* LAMAK. *ET* DC.

Nonnea is a small genus comprising of 30 species.[3] *Nonnea pulla* is a much branched, spreading, erect, annual, wild herb growing in waste places under xerophytic conditions. The species is marked by great morphological variability especially in size of flowers and leaves. The cytological analysis of the morphological variants by the author indicated the existence of intraspecific polyploidy in the species.[2]

This note concerns the morphological and cytological observations in the naturally existing diploid and tetraploid forms of *N. pulla*.

Precisely $4x$ taxon exhibited appreciable gigantism in most of the characters. They were more robust and stout with significantly larger leaves, flowers, fruits and seeds in contrast to the diploid. In fact the two races within the complex could be distinguished on the basis of flower size. The epidermal, stomatal and palisade cells also exhibited significant enhancement in the tetraploid in short comparison to the diploid. The pollen-grains were also comparatively bigger in tetraploid with 100% fertility. Tetraploidy did not affect fruit setting as the average number of fruits per plant in the tetraploid was almost the same as in diploid.

As a rule, diploid showed normal meiotic course, with high degree of fertility. There was regular pairing and seven bivalents were observed at Metaphase-I (Fig. 1). At anaphase-I, bivalents disjoined neatly and there was 7/7 separation (Fig. 2). In the tetraploid 14 bivalents were counted at Metaphase-I (Fig. 3). Metaphase-I was neat and no univalents or multivalent configurations were noticed. Figure 4 depicts normal anaphase-I with 14 univalents at either pole.



FIGS. 1–4 (× 710)

Fig. 1. Metaphase I (polar view) showing seven bivalents. Fig. 2. Anaphase I with seven chromosomes at either pole. Fig. 3. Metaphase I (lateral view) showing 14 bivalents. Fig. 4. Anaphase I with 14 univalents at either pole.

Taking the present data in conjunction with that already published[1] (*cf.* Darlington and Wylie, 1955), it is quite evident that out of 30 species belonging to this genus (Willis, 1957) only 5 have been investigated cytologically. It will be observed that there are 2 haploid numbers reported in the genus *Nonnea*. The overall series being $x = 7, 8$. Although with the little data in hand it is difficult to infer the base number of the genus as a whole, the existence of $2x$ and $4x$ races of *N. pulla* with $n = 7$, $n = 14$, respectively, points that the basic number (x) for this species is seven. The existence of a natural polyploid series has not been recorded so far in other species of *Nonnea*. Polyploidy apparently seems to have contributed but little in the evolutionary course of various species.

As stated earlier the meiosis of $4x$ taxon is characterized by only bivalent formation, multivalents being absent. Experience has shown that multivalents pairing is primarily a feature of auto- or segmental allopolyploids, whereas bivalent formation indicates hybrid origin or allopolyploid nature. On this reasoning (cytological ground) it is tempting to suggest that $4x$ taxon may very well be an allopolyploid. The tetraploid also showed a very high pollen fertility and a fairly good seed setting. This point is also in favour of the above conclusion.

The author records his thanks to Dr. A. N. Banerji for providing necessary facilities to carry out the present investigation.

Department of Botany, Deshbandhu College, New Delhi-19, *April* 14, 1960.

C. P. MALIK.

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ADDITIONAL VECTORS OF TRISTEZA DISEASE OF CITRUS IN INDIA

TRISTEZA a disease of major economic importance, is now known to occur in many citrus plantations of Maharashtra[7] in India, Brazil, Argentina, Uruguay, Union of South Africa, Australia, California, Hawaii, New Zealand and Israel.

In 1946, Fawcett and Wallace[1] demonstrated the virus nature of the tristeza disease and simultaneously Meneghini[2] in Brazil, showed *Aphis* (*Toxoptera*) *citricidus* Kirk., to be the vector. Since then, this aphis has been found to be the principal carrier of tristeza virus in tropical and sub-tropical parts of the world by Hecter,[3] Valiela and Fernandez,[4] Hughes,[5] McAlpin,[6] and Vasudeva *et al.*[8] Dickson *et al.*,[9] however reported *Aphis gossypii* Glover, as a somewhat inefficient vector in California. Norman and Grant[10] in Florida transmitted the virus by *Aphis spiræcola* Patch., although it was also less efficient than *A. citricidus*. Bennett and Costa,[11] in Brazil found that except *Aphis citricidus* no other insect could transmit the virus. Dickson[12] tested a number of insect species including *Myzus persicæ* Sulz. and mites, but the virus could be transmitted by *Aphis gossypii*, alone, or in combination with species of membracids, *viz.*, *Spissistilus franciscanus* (Stal), *S. nigricans* (Van Duzee), *S. festinus*, and *Stictocephala* sp. The evidence for membracids however continues to be inconclusive.

During 1958 and 1959, experiments were conducted at Poona to test the ability of *Aphis gossypii* and *Myzus persicæ* to transmit the tristeza virus and the results are reported in this paper.

In transmission tests, only insects reared in the insectary were utilized. *Myzus persicæ* was colonized on Chinese cabbage (*Brassica pekinensis*, Rupr.) and *Aphis gossypii* on egg plant (*Solanum melongena*, L.). 50 to 100 apterous aphids were used to inoculate one seedling. The source of virus was two sets of one year old Mexican or Key lime plants infected with tristeza through *Aphis citricidus* from grape fruit (*Citrus paradisi*, Macf.) and sweet orange (*Citrus sinensis* Osbeck), respectively. The insects were allowed to feed in dark on diseased plants for 24 hours and then on young Key lime as well as on Kagzi lime plants, and then killed with nicotine spray. The test plants were kept in a separate glasshouse for observations.

Out of 12 Key lime and 8 Kagzi lime seedlings, inoculated through *Myzus persicæ*, all were diseased. In the case of *Aphis gossypii*, out of 20 Key lime plants 12 were infected. The typical disease symptoms as described by Wallace and Drake[13] manifested in young leaves of test plants after 45 days following inoculation. The presence of virus in these plants was further confirmed by indexing them on Key lime plants through *Toxoptera citricidus*.

The strain of virus present in India is similar to that present in Argentina, and the above results showed that it can be transmitted by *Aphis gossypii* as well as by *Myzus persicæ* in addition to *A. citricidus*. Transmission of a severe strain of tristeza by *Aphis gossypii* was earlier reported by Norman,[14] and Norman and Grant.[15]

Myzus persicæ has been shown to be the vector of tristeza virus for the first time and it is likely that different strains of this virus may be transmitted by other aphid species in various localities.

Divn. of Mycology and Plant Pathology, I.A.R.I., New Delhi-12, *May* 25, 1960.

P. M. VARMA.
D. G. RAO.
R. S. VASUDEVA.

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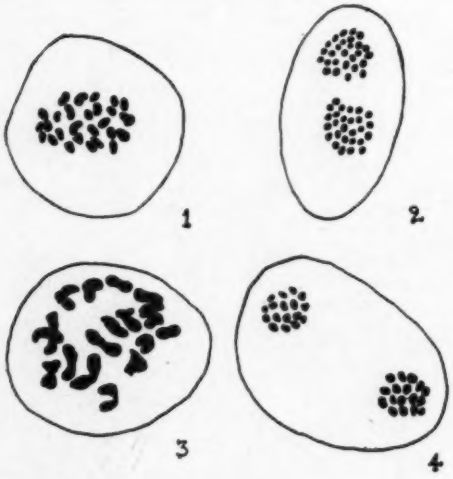
CHROMOSOME NUMBERS IN TWO COMPOSITAE WEEDS

In the course of cytological studies in some of the compositæ weeds, the following chromosome numbers were determined (Table I). The

TABLE I

No.	Name	Chromosome number (n)
1	*Vernonia anthelmintica*	27
2	*Lagaska mollis*	17

counts reported here are believed to be new as they are not listed in the recent compilation of *Chromosome Numbers* by Darlington and Wylie (1955) and in the *Cytogenetics and Plant Breeding* by Chandrasekhar and Parthasarathy (1953). The weeds stated below are very common in this college farm.



FIGS. 1–4

(1) Metaphase in *Vernonia anthelmintica*.
(2) Anaphase in *Vernonia anthelmintica*.
(3) Metaphase in *Lagasca mollis*.
(4) Anaphase in *Lagasca mollis*.

The flower-buds were fixed in acetic alcohol (1 : 3) and staining was done in acetocarmine.

The somatic chromosome number was determined by squashing the root-tips. The root-tips were fixed in the acetic alcohol (1 : 3) for 3 hours and hydrolysed in 1/N HCl for 5 minutes at 60° C. and stained in acetocarmine.

My thanks are due to Sri. B. Venkoba Rao, Principal, for his help and advice.

Agricultural College, Hebbal, Bangalore-6, *March* 18, 1960.

N. S. PARAMESWAR.

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INHERITANCE OF LEAF CHLOROSIS IN AN INTERSPECIFIC CROSS BETWEEN *TRITICUM DURUM* AND *T. DICOCCUM*

With the object of breeding for combined resistance to brown and black rusts, a cross was made between E. 2025 (*durum*) and I.C. 1057 (*dicoccum*), the former highly resistant to brown rust and the latter to black rust. In the F_2 generation of this cross a good number of plants showed yellowing of the leaves (chlorosis) whereas neither of the parents showed any type of chlorosis. About 60 to 65 days after sowing, yellow spots appeared on the leaves of the susceptible plants. Most of the yellow spots later on turned to complete yellow. Still later in the season the uniform yellow colour turned to a reddish tinge. The leaves afterwards dried up completely (Fig. 1). The cross was studied with a view to determining the mode of inheritance of this type of leaf chlorosis. The study

FIG. 1. Inheritance of leaf chlorosis in an interspecific cross between *Triticum durum* and *T. dicoccum*. (A) Normal plant. (B) Chlorotic plant.

was conducted at the I.A.R.I., New Delhi, during the years 1957-58 and 1958-59.

The F_1 was normal like the parents. The data collected on the F_1, F_2 and B_1 generations are presented in Table I.

Segregation of the F_2 population into 13 normal : 3 chlorotic suggests the epistatic action of an inhibitor gene suppressing the phenotypical expression of chlorosis. The character of leaf chlorosis itself is, however, dominant over the normal. The back cross of the F_1 to the paren

TABLE I

The mode of inheritance of leaf chlorosis in a cross between E. 2025 (T. durum) *and I.C. 1057* (T. dicoccum)

Material	Number of plants			χ_2	P-Value	Mode of inheritance
	Normal non-yellow	Chlorotic yellow	Total			
P_1 E. 2025 (normal) ..	140	..	140	..	..	..
F_1 ..	26	..	26	..	..	..
F_2 Observed ..	329·0	93	422	2·994	·10–·05	13 normal : 3 chlorotic
F_2 Expected (on the basis of 13 normal : 3 chlorotic)	342·9	79·1	422	..	..	..
B_1 with E. 2025 Observed ..	29	..	29	..	..	..
do. Expected ..	29	..	29	..	..	..
B_1 with I.C. 1057 Observed ..	40	13	53	·00621	·95–·50	3 normal : 1 chlorotic
do. Expected (on the basis of 3 normal : 1 chlorotic)	39·8	13·3	53	..	..	..
P_2 I.C. 1057 (normal) ..	120	..	120	..	..	..

TABLE II

Segregation of leaf chlorosis among the F_3 families of the cross E. 2025 × I.C. 1057

Material	Number of families				χ_2	P. Value	Mode of segregation
	Homozygous normal	Heterozygous	Homozygous chlorotic	Total			
F_3 Observed ..	81	105	7	193	−2·938	·30–·20	7 : 8 : 1
F_3 Expected (on the basis of 7 : 8 : 1)	84·4	96·5	12·1	193	..	..	..

E. 2025 gave progeny that were all normal (non-yellow). In the back cross to the other parent I.C. 1057, the progeny segregated in the ratio of 3 normal : 1 chlorotic, indicating that I.C. 1057 is the double recessive.

The observations made on the F_3 families are summarised in Table II.

The segregation of the F_3 families into 7 homozygous normal : 8 heterozygous : 1 homozygous chlorotic confirms the F_2 data.

The segregation of leaf chlorosis studied within each of 105 heterozygous F_3 families was also in accordance with the expectation, assuming the operation of an inhibitor gene for suppressing the dominant action of the gene for chlorosis.

Observations made on a cross involving I.C. 1057 and another *durum* wheat (E. 931) have provided confirmation for the assumption that it is E. 2025 and not I.C. 1057 which carries the factor for leaf chlorosis. The exact nature and causes of chlorosis reported here are not known, but examination of the leaf showed no indications of any pathogenic organisms, fungal or virus, responsible for this phenomenon.

C.T.R.I., G. S. MURTY.*
Rajahmundry, *April* 29, 1960. K. L. SETHI.

* Director, Central Tobacco Research Institute, Rajahmundry.

ADDITIONS TO THE FLORA OF KUTCH

KUTCH is situated at the western extremity of India. Botanically it is an under-explored area. During our recent exploration of Kutch District we collected several plants, which have not so far been reported from the area by the earlier workers such as Blatter,[1] Thakar[2] and Kapadia.[3]

The present note enumerates some such species with short notes on their general distribution in western India.

Tamarix articulata Vahl. Symb., 1791, 2, 48 : Hook *f.*, *Fl. Br. Ind.*, 1874, 1, 249 (Tamaricaceæ).

Near Old Port of Jakhau, *Kanodia* 62011 ; Old Port Mundra, *Kanodia* 62060.

A shrub frequently growing in saline soil of tidal zone. This plant occurs in Panjab, Sind and Rajasthan but is not reported so far from Kutch, Saurashtra and Bombay.

Trigonella occulta Delile in *DC. Prodr.*, 2, 185 ; Hook. f., *Fl. Br. Ind.*, 1876, 2, 87 (Papilionaceæ).

Joroda Badi in Jakhau, *Kanodia* 62046.

This plant is reported earlier from Lucknow, Ahmedabad and also as a rare plant in Sind. It has not been reported so far even from adjacent areas of Kutch such as Saurashtra, Bombay, Panjab and Rajasthan. It is quite common in moist places around Jakhau.

Astragalus prolixus Sieb. in *Fl. Aegypt. Exsice. ex Bunge Monogr. Astr.*, 1868-69, 1, 9 : Hook. f., *Fl. Br. Ind.*, 1876, 2, 121 (Papilionaceæ). Old Port Mundra, *Kanodia* 62043.

The earlier report of this plant in India is from Lahore (Panjab) and Sind. It is not reported from Saurashtra, Kutch, Rajasthan and Bombay. It is common on saline soil around Mundra.

Xanthium strumarium Linn. Boiss. Fl. Orient., 3, 251 ; Hook. f., *Fl. Br. Ind.*, 1881, 3, 303 (Compositæ).

Near Kharsara Talao, Bhuj, *Jain* 61493.

This weed has spread wild in several parts of India in waste places. Forest Department staff of Kutch informed us that the plant has entered Kutch only recently.

Heliotropium rariflorum Stocks in *Kew Journ. Bot.*, 1852, 4, 174 ; Hook. f., *Fl. Br. Ind.*, 1883, 4, 152 (Boraginaceæ).

Near Old Port Jakhau, *Kanodia* 62009 ; Old port Mundra, *Kanodia* 62062.

This plant occurs in Rajasthan, Panjab and Sind but not so far reported from Gujarat and Bombay. It is common in Kutch in dry loose saline soil.

Trichodesma amplexicaule Roth. Nov. Sp. Pl., 1821, 104 ; Hook ; f., *Fl. Br. Ind.*, 1883, 4, 153 (Boraginaceæ).

Jorodi Badi Jakhau, *Kanodia* 62043 A.

The plant has not been reported so far from Kutch. The species is very close to *T. indicum* Br. from which it can be distinguished by the auricles at the base of the calyx which in this species turn inwards.

Euphorbia dracunculoides Lamk. Encyc. Method, 1786, 2, 428, Hook. f., *Fl. Br. Ind.*, 1887, 5, 262 (Euphorbiaceæ).

The plant is a common weed in cultivated fields but has not been reported so far from Kutch, Saurashtra and Sind.

Asparagus dumosus Baker in *J. Linn. Soc.* 14, 609 ; Hook. f., *Fl. Br. Ind.*, 1892, 6, 315 (Liliaceæ).

Narayansarowar, *Jain* 61954 ; Old Port Jakhau, *Kanodia* 62010 and 62017.

Cooke[4] remarked about this plant as endemic to Sind. Santapau[5] reported it from Saurashtra. The plant is very common on all the coastal sands in Kutch.

Ephendra foliata Boiss. Fl. Orient., 1881, 5, 761 ; Hook. f., *Fl. Br. Ind.*, 1890, 5, 863 (Gnetaceæ).

On way to Kala Dungar, Khavda, *Jain* 61856.

The only report of this plant in India is from Punjab and Rajasthan. It has not been reported from Bombay and Gujarat States. We collected it from Kutch only on one occasion so far, climbing among the bushes of *Prosopis spicigera* Linn.

We are grateful to Dr. J. C. Sen Gupta, Chief Botanist and Shri R. S. Rao, Regional Botanist, Botanical Survey of India, for their kind advice and help in the preparation of this note.

Botanical Survey of India, Western Circle, Poona, *May* 14, 1960.

S. K. JAIN.
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PRE-MEIOTIC SOMATIC-REDUCTION IN WHEAT

POLY-HAPLOIDS with $2n = 21$ have been isolated and induced in varieties of bread-wheat by several workers.[1,2] The cytological behaviour of nulli-haploids with $2n = 20$ have also been studied.[3,4] The occurrence of sporocytes with euhaploid or nulli-haploid chromosome numbers along with the normal cells has, however, been recorded only twice.[5,6]

During the identification of monosomic lines of the wheat variety Chinese Spring, one anther of a plant monosomic for chromosome XX (2 D) according to the revised nomenclature of Sears,[7] had cells with chromosome number ranging from 16 to 21. A majority of the cells studied (9 out of 15) had $2n = 20$ (Figs. 1 and 2). The chromosome number 16 (Fig. 3) 18, 19 and 21 (Fig. 4) were observed in one, two, two and one cell respectively. All other pollen mother cells showed $20_{II} + 1_{III}$ at first meiotic

FIGS. 1–4

Fig. 1. A cell showing $3_{II} + 14_{I}$. Fig. 2. A cell showing $5_{II} + 10_{I}$. Fig. 3. A cell showing $3_{II} + 10_{I}$. Fig. 4. A cell showing $4_{II} + 13_{I}$.

metaphase. The pairing behaviour noted in the aberrant cells is given in Table I.

TABLE I

Pairing behaviour in cells with reduced chromosome number

Cell No.	Chromosome number	No. of bivalents		Number of univalents
		Ring	Rods	
1	16	2	1	10
2	18	2	..	14
3	18	3	1	10
4	19	3	..	13
5	19	2	1	13
6	20	3	..	14
7	20	3	..	14
8	20	3	2	10
9	20	3	..	14
10	20	3	1	12
11	20	3	1	12
12	20	..	1	18
13	20	3	..	14
14	20	3	..	14
15	21	3	1	13

From Table I, it will be seen that some bivalents occurred in all the cells. Fourteen cells showed both closed and open bivalents and in one cell only one rod bivalent was present. The number of closed bivalents ranged from 1 to 3 per cell, with a majority of cells having 3.

In a 42-chromosome stable derivative of a wheat-*Agropyron* cross, Knott[5] observed five cells with 22 and four cells with 20 chromosomes. He attributed their occurrence to somatic reduction in a pre-meiotic cell. From the distribution of chromosome numbers and from the constancy of the number of closed bivalents in each chromosome number group, he concluded that a single initial reduction was responsible for the origin of these cells. The chromosome numbers in the fifteen cells observed in the present instance do not fall into any regular pattern and it is difficult to draw any conclusion as to the number of pre-meiotic cells in which somatic reduction has occurred. Theoretically any cell having a complete set of seven chromosomes of any one of the three genomes of hexaploid wheat is capable of undergoing division and as such a single reduction followed by subsequent divisions with chromosome eliminations could give rise to cells with different chromosome numbers. The other possibility is that somatic reduction took place initially in more than one cell. The nine 20-chromosome cells, with one exception, had 3 closed bivalents, suggesting that they may be derived from a single reduction followed by the mitotic duplication of that cell. Sears and Okamoto[7] in the variety Chinese Spring and Riley and Chapman,[8] in the variety Holdfast, have demonstrated the presence of a gene system (on chromosome V of Chinese Spring, H-H chromosome of Riley and Chapman) which restricts pairing to completely homologous chromosomes. In the absence of this system pairing can also take place between homœologous chromosomes. Thus a nulli-haploid for this chromosome shows, besides increased frequency of bivalents, associations involving four or more chromosomes. None of the nulli-haploid cells observed during the present study had any configuration higher than bivalent. These cells, therefore, should be deficient for a chromosome other than chromosome V of Sears and Okamoto or chromosome 'H' of Riley and Chapman.

Huskins[9] observed and later induced in monosomic wheat and some other plants, pairing and segregation of homologous chromosomes in somatic tissues. The fact, that closed bivalents occurred regularly in all the cells studied by the author, suggests that whole pairs of chromosomes were present in the nulli-haploid cells. Hence chromosome distribution in the cells which have undergone somatic reduction should have taken place at random without pairing and segregation of homologous chromosomes.

I am indebted to Dr. M. S. Swaminathan for guidance and helpful suggestions and Dr. B. P. Pal and Dr. A.B. Joshi for their interest in the study. Thanks are due to Mr. Bishamber Lal for his help in making fixations.

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DEMONSTRATION OF "PROPORTIONALITY ERRORS"

THE concept of DNA constancy per set of genome in a given species was first put forth by Boivin, Venderly and Venderly[1], Venderly and Venderly[7], and later by Mirsky and Ris.[2] Their observations were based on the chemical determination of the average DNA-content of nuclei. This concept has now been amply confirmed, at the level of individual nuclei, by the microspectrophotometric methods of measuring the DNA-content of individual nuclei in visible light. Some instances of apparent deviations have, however, emerged in some of these studies on different materials.

Various authors while interpreting their data as showing non-constancy of DNA seem to have assumed that deviations from proportionality between Feulgen dye—and DNA-content causing "proportionality errors" would always be negligible. Patau and Swift[4] pointed out that "proportionality errors" have, in many cases, obviously been small but that the assumption that they would always be negligible is unwarranted. A disproportionality between Feulgen dye—and DNA-content may be due to the disproportionality between the DNA-content and the number of aldehyde groups released by hydrolysis for the Schiff reaction. It may also be due to a disproportionality between the number of available aldehyde groups and the amount of Feulgen present. The latter kind may arise by incomplete staining, by overstaining or by loss of stain during the treatment with the sulphurous acid bleaching solution and subsequent dehydration. The duration of dehydration is largely found to have no noticeable effect on the intensity of staining (Srinivasachar and Patau).[6]

In this note how overlooking of an important step in the preparation of Feulgen slides for photometric measurements of DNA-contents of nuclei leads to the demonstration of "Proportionality errors" is reported.

TABLE I

Disappearance of a difference in mean dye-content between two slides after a second treatment with the sulphurous acid bleaching solution. Fixation : acetic alcohol 1 : 3 ; hydrolysis : hydrochloric acid, eight minutes

30 minutes additional treatment with sulphurous acid bleaching solution				
	Before		After	
Number of replications per nucleus	4		2	
Slide No.	1	2	1	2
Prophase ..	22·74 23·55	20·76 18·56 18·74 19·47 20·82	12·97 13·34	13·19 15·73 15·09 14·60 12·96
Metaphase	24·77 22·16	18·04 19·56 19·00 19·84	13·70 15·07	12·14 13·83 12·62 13·18
Anaphase ..	22·76 23·20	19·72 18·80 23·35	11·06 13·32	13·52 13·34 13·13
Mean ..	23·20	19·72	13·24	13·60
	Significance of difference : $t_{16} = 5{\cdot}45$; $P < 0{\cdot}0002$		decrease : 42·9%	31·0%

During the course of the DNA measurements of nuclei in the meristem of onion roots, by using the microspectrophotometric two-wavelength method of Patau[3] with some modifications (Patau and Srinivasachar[5]) an inconsistency was found between two slides which contained sections from one sample of equally fixed roots and which had been hydrolysed and stained together. The dye-contents, measured in arbitrary units, differed significantly. Search for an explanation revealed that these slides with eight others were passed through the sulphurous acid bleaching solution and the dehydration series with pairs of slides held back to back and that it had been omitted to separate them. Thus it appeared possible that some sulphurous acid bleaching solution had been transferred between the adherent slides into the alcohol grades in spite of the rinsing with water. The last slides to be taken out of the sulphurous acid

bleaching solution might have been exposed to a much higher contamination of the alcohol with the sulphurous acid bleaching solution than the first ones. If this contamination should have a destaining effect, the difference in the nuclear dye-content between the two slides would be readily understandable. To test this both the slides were demounted and once more treated with the sulphurous acid bleaching solution for three periods of ten minutes each. This resulted in a conspicuous drop of the nuclear dye-content in both the slides to practically the same level (Table I). The same repeated treatment with the sulphurous acid bleaching solution was applied to two other slides which had already shown initially good agreement in the dye-content. Both lost similar amounts of dye.

The unexpected difference in the DNA-contents that arose as a result of a discrepancy in the preparation of the Feulgen slides led to a series of experiments with the sulphurous acid bleaching solution. These experiments, besides providing a plausible explanation to an otherwise baffling situation, gave clear evidence of proportionality errors (Srinivasachar and Patau).[6]

This work was done at the University of Wisconsin, Madison, under the guidance of Dr. Klaus Patau. My grateful thanks are due to him and to the University of Wisconsin for financial assistance.

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University of Wisconsin,
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OBITUARY—AUGUST THIENEMANN

THE death of Prof. Thienemann on 22nd April, 1960 at the age of about eighty years removed from the world of science a savant who was one of the founders of modern Limnology. After retirement from the Hydrobiologischen Anstalt at Plön of the Max-Planck-Gesellschaft, West Germany, he continued as Director Emeritus at the same Institute and was an active contributor to science and philosophy of science for the past several years.

Thienemann has been in the forefront of hydrobiological work for over forty years. His contributions cover a very wide range of subjects and each of his earlier major papers has itself been a forerunner of a distinct branch of the then new and fast-growing discipline of aquatic biology. Many of his studies bore the stamp of pioneering and to his institute came workers on freshwater problems from all over the world. Limnology as a science came to its own only long after marine biology, but in building up this science Thienemann and his school, among whom may be counted many of the outstanding names in this field, have a unique place. Apart from the work on temperate waters of Europe Thienemann organised, after the First World War, the German Hydrobiological Sunda Expedition to the Indonesian Archipelago. The work of this expedition till this day is practically the only comprehensive attempt to analyse the complex problems of tropical limnology. Apart from his original contributions, Thienemann gave much of his time to editing the well-known *Archiv für Hydrobiologie* and *Die Binnengewasser*. Many who have come in contact with him will always remember him as a scientist of wide sympathies and philosophic understanding of human problems, one of the last few intellectuals of a previous generation who valiantly kept continuity with modern developments and held an even balance between the synthetic and analytical approaches to studies in aquatic biology. His death will be deeply mourned by a very large body of biologists all over the world whose work has been influenced by the pioneering studies of Thienemann.

N. K. PANIKKAR.

REVIEWS

Scientific Papers of Sir Geoffrey Ingram Taylor. Vol. II—*Meteorology, Oceanography and Turbulent Flow.* Edited by G. K. Batchelor, F.R.S. (Cambridge University Press, London N.W. 1), 1960. Pp. 515. Price 75 *sh.*

This valuable enterprise undertaken by Dr. G. K. Batchelor of bringing out in a collected form the complete research work of Sir Geoffrey Ingram Taylor in a series of volumes has been welcomed by scientists all over the world. These researches were spread over a long period of nearly 45 years. The enthusiasm with which the publication of the first volume in 1958 containing Sir Geoffrey's papers on "The Mechanics of Solids" was received proved the importance of this undertaking.

The present volume is the first of three to be devoted to Sir Geoffrey's work on the mechanics of fluids. It contains 45 papers covering meteorology, oceanography and turbulent flow. While the majority of papers are those that have been reprinted from the *Proceedings and Transactions of the Royal Society*, there are several papers that were written for Government Departments or Advisory Committees, mostly during the last War, and are being published for the first time.

Professor Taylor's special gift lies in the physical insight he brings into mathematical problems and the close correlation that he maintains between mathematics and experiment, which has contributed in no small measure to the development of these subjects in the experimental and engineering fronts. About half the number of the papers in the volume deal with the theory of turbulence—a subject to which the contributions by Taylor have been recognised to be of fundamental importance. In these papers the statistical theory of turbulence has been developed, and they discuss various aspects of turbulence such as the correlation between the velocity of the same particle at different instants or between simultaneous velocities at two different points, the dynamics of decay of turbulence, isotropic and homogeneous turbulence and finally the spectrum of turbulence. Most of these papers contain experimental details as well, and these relate to the distribution of velocity between concentric rotating cylinders and to turbulent flow in long pipes. Besides these, the volume contains a number of papers on meteorology dealing with eddy motion in the atmosphere and the formation of fog and mist. The papers discussing tidal oscillation and tidal friction in sea will be of special interest to oceanographers.

The publishers state in the front paper cover of the volume that "it will be of particular interest to meteorologists, oceanographers and geophysicists and will also appeal to a wider range of scientists concerned with fluid mechanics in general and with turbulent flow in particular" and we fully endorse this view.

V.

The Measurement of Power Spectra. By R. B. Blackman and J. W. Tukey. (Dover Publications Inc., N.Y.), 1959. Pp. 190. Price $ 1.85.

This small Dover Publication contains a wealth of information on the practical aspects of measurement and estimation of power spectra of stationary, ergodic random processes. Such processes form a large section of the random processes that one encounters in practice, and so the material presented in this book should find wide application.

The authors establish practically workable formulæ and criteria for use at every stage of the measurement procedure, from data-gathering to final machine computation. For instance, criteria are given for (*a*) estimating the amount of data that must be gathered to obtain the spectrum to a desired accuracy, (*b*) the choice of spectral windows (or weighting functions), (*c*) methods for pre-whitening, and (*d*) estimating the cost of machine computation. The theoretical limits to the accuracy of various procedures are indicated.

The account is mostly heuristic and is primarily intended for those directly responsible for the actual design and execution of measurement programmes. However theoreticians would be well advised to read the book, if only to get an idea of what it takes to measure a spectrum which they take for granted in their analyses.

The reviewer's only criticism of the book is in regard to the arrangement of the material. It is a book in two parts, of which Part II contains proofs or generalizations of remarks made in Part I. The rather excessive cross-referencing between Parts I and II, necessitated by the

arrangement of the material, is extremely cumbersome. In the journal articles (of which this book is a reprint), this was perhaps unavoidable. In book form, more thought as to the arrangement would have been welcome.

M. M. SONDHI.

Physical Methods of Organic Chemistry, Vol. 1, —Part I. Third Edition. Edited by Arnold Weissberger. (Interscience Publishers, New York-1, N.Y.), 1959. Pp. 894 + Index. Price $ 24.50.

The popularity of this reference work on the *Technique of Organic Chemistry*, edited by Weissberger, has been so great that reissue of several of the volumes in the series has been long overdue and hence the new edition of the volume under review will be widely welcome. The Second Edition of this volume on physical methods of organic chemistry was published in 1949 in two parts. The publication of Part III in 1954 helped to bring the volume (what was then) up-to-date. The recent developments in the physical methods employed in organic chemistry have been so rapid that it is not surprising that the editor and the publishers decided to bring out a new edition instead of simply reprinting the old one to meet the continued demand of this well-known series. These new developments have helped not only in getting greater precision in the available data but also in extending the areas of information to be obtained from them. Especially in the field of organic microanalysis the physical methods, such as electron spin resonance, nuclear magnetic resonance and neutron activation analysis, are rapidly replacing well-known classical methods.

To cope with this expansion in the subject, the original three parts of the volume have in the third edition been enlarged to four parts, (from 2,500 pages to 3,500 pages) with the addition of several new chapters. In Part-I under review the following new chapters have been added: Chapter-I on Automatic control; Chapter-II on Automatic recording; Chapter-III on Weighing and Chapter-V on Determination of particle size and molecular weight. In all the other chapters extreme care has been taken to rectify omissions, effect corrections and incorporate new additions and latest reference thus bringing the entire work up-to-date.

Weissberger's series of volumes on the *Technique of Organic Chemistry* are indispensable to all scientific libraries and organic chemistry laboratories. Those who are already in possession of the old edition should go in for this completely revised and augmented edition. It is recommended not only to organic chemists for whom the methods described have special appeal but also to research workers in allied fields like physicists, biologists and biochemists who will find practical and guiding information on organic chemical problems which they may have to tackle in the course of their investigations.

The succeeding parts in this volume will be eagerly awaited by workers in the field.

A. S. G.

Elements of Radio Engineering. Second Edition. By H. I. F. Peel. (Cleaver-Hume Press Ltd., London), 1960. Pp. 257. Price 13 *sh.* 6 *d.*

This is one of numerous British text-books that are put out from time to time to help those who have limited time to attend formal courses but who wish to pass examinations conducted by Institutes such as the City and Guilds, British I.R.E., etc. The emphasis is invariably on worked numerical examples, selected examination questions and the like. The readers are told that if they are familiar with Ohm's Law, well then, they have the necessary background; that, if they do not know a.c. theory, there is no need to get nervous because the requisite material will be developed in the book itself.

Within the confines of the task imposed on himself, the author produces a readable text on the basic principles of electron tubes and circuits that are needed to make up a broadcast receiver. The processes of amplification, oscillation, modulation, detection and rectification are explained in simple terms with the aid of neat circuit schematics and relevant tube characteristics. Basic measurements in radio-engineering are briefly described. There is a chapter on the working of the cathode-ray-oscillograph. The Puckle time-base circuit that embellishes the cover page belongs to this chapter.

At the fag-end of the book, Transistors claim about 5 pages. For a revised edition of the text appearing in the year 1960, this is hard to justify. Semiconducting devices have come into widespread use and one cannot fight shy, even from the point of view of the radio technician, of their basic theory and circuit applications. Instruction in the subject will stand to gain by bestowing equal attention on tubes and transistors. A postponement in this regard will only make future adjustment difficult.

S. SAMPATH.

Chemical Analysis : Systematic Analysis of Surface-Active Agents, Vol. 12. By Milton J. Rosen and Henry A. Goldsmith. (Interscience Publishers, New York, N.Y.), 1960. Pp. xvii + 422. Price $ 13.50.

The vast progress made in the surfactants chemistry in recent years has made it possible for synthetic surface-active agents to successfully overtake the soap industry in most of its applications. Today surfactants are present, in some form or other, in a vast number of industrial and household preparations. Invariably a number of surfactants are blended together and rarely one comes across a single or unbuilt surfactant in a commercial sample. Analysis and identification of the various constituents present in the commercial sample is a complex problem.

Though numerous papers and several review articles on the methods of analysis of surfactants are available, there is no single authoritative book dealing with the subject.

The aim of the book, as the authors put it, is not merely to compile analytical methods published in various journals, but to systematise and rationalise the analysis of surfactants by applying modern methods of organic analysis. In addition to incorporating both published and unpublished information from authoritative sources, they have drawn extensively on individual personal experience in their fields.

The subject-matter of the book has been judiciously divided into five chapters, each dealing with a specific problem. In Chapter 1 the surfactants are classified, depending on the elements present, mainly into 12 basic classes. Chapter 2 deals with the detection, isolation and estimation of surfactants. Chapters 3 and 4 deal with qualitative and quantitative analyses of surfactants while Chapter 5 deals with the separation of individual surfactants from mixtures. Several methods of analysis for each type are described followed by a critical discussion giving the scope and limitation of each method, thus opening the field for possible improvement or development of an altogether new method. A number of tables classifying various types of surfactants are given in the body of the book. In the appendix a long table lists the representative commercial samples and their chemical nature for quick identification of the nature and type of surfactant under reference. As in organic analysis, several road maps are furnished in the chapter on separation of mixtures. Each chapter is followed by a very useful list of references (up to the end of 1957), subject-index being provided at the end of the book.

The material in the book has been presented in such a way as to render the book highly useful as a reference book or a guide to research worker in the field. The reviewer has no hesitation in stating that the monograph is indeed a very valuable addition to the series and should be an essential addition to libraries of all chemical laboratories, specially those that are engaged in surfactant work.

B. C. SUBBA RAO.

The Chemical Analysis of Air Pollutants. By Morris B. Jacobs. (*Chemical Analysis*, Vol. 10.) (Interscience Publishers, New York, London), 1960. Pp. xviii + 430. Price $ 13.50.

This book is a welcome addition to the popular series of monographs on 'Analytical Chemistry and its Applications'. It needs no introduction particularly to those who are already familiar with the author's other two excellent monographs of this series. His long and intimate association with the Department of Health, New York City, has enabled the author to write with authority and clarity on a theme which though somewhat elusive is vast in scope and content.

The monograph is of moderate size (43[illegible] pages) containing 17 chapters. The first chapter begins with a proper emphasis on sampling. No analysis however elaborate and painstaking is of much value unless preceded by careful sampling. This is more true of air pollutants whose composition varies with several factors such as the distance from the source of pollution, the time and the seasons, the velocity and direction of wind, etc. Sampling methods therefore have been described at length wherever necessary. In the next chapter is given a concise account of the gas laws followed by methods of measurement of gas volumes and gas velocities. The next five chapters deal with the analysis of particulate matter falling out of the atmosphere, suspended in the atmosphere and exhausted to the atmosphere. Chapters 8-12 are devoted to gaseous pollutants. The next chapter is exclusively devoted to radioactive fall-out, and the analysis of radionuclides using counting, chromatographic and chemical methods. Special mention should also be made of chapter 16 which gives a critical assessment of the present-day position of odour analysis. The last chapter on Air Contaminant Monitoring Instruments is followed by a useful

Appendix containing air pollution data relating to several cities in U.S.A.

Numerical examples illustrating methods of calculation and self-explanatory diagrams of the gadgets make for easy understanding. This volume is recommended without any reservations both to the aspiring student and the professional analyst.

P. R. SUBBA RAMAN.

The Biosynthesis and Secretion of Adrenocortical Steroids—Biochemical Society Symposia No. 18. (University Press, Cambridge, London N.W. 1), 1960. Pp. vi + 111. Price 15 *sh.*

This monograph is a record of the proceedings of a symposium held by the Biochemical Society at London in early 1959. Several aspects of the biosynthesis and secretion of the adrenocortical steroids have been reviewed.

The first of the articles is by I. E. Bush wherein the separation, identification and quantitative determination of the steroid hormones of the adrenal cortex are discussed. The biosynthesis of the adrenocortical steroids has been described in the next article by J. K. Grant. He gives, in detail, the reactions as well as the enzyme systems involved in the biosynthesis of these hormones and concludes with a study of the role that vitamin C may play in the biosynthesis of adrenocortical steroids. The two subsequent articles by T. Symington and P. J. Ayres have been devoted to the morphology of the adrenal cortex and the relationship of the secretions to the histological zones. Of particular interest in the latter is the conclusion that the metabolism of specific steroid substrates varies greatly with the zones they are present in. The next article by R. V. Short provides conclusive evidence for the ability of the adrenal gland to secrete the three different types of steroids—androgens, œstrogens and progestogens. We are still, however, in the dark as to the precise function of these secretions in a normal adrenal gland. The role of the hypothalamus and its as yet uncharacterized hormonal product—corticotrophin releasing factor—has been discussed at length by M. Vogt while the last article by N. Saba is a critical review of the mechanism of ACTH action.

This monograph can be regarded more as a compilation of review articles on several aspects of secretion of adrenal cortex and has the merit of bringing one up-to-date on the recent developments on this subject. P. S. SARMA.

Photoperiodism in Plants and Animals. Edited By Robert B. Withrow. (American Association for the Advancement of Science, Washington D.C.), 1959. Pp. xvii + 903. Price $ 14.75.

This book of nearly 900 pages records the proceedings of the Conference on Photoperiodism held in Gatlinburg, Tennessee, during October 29 to November 2, 1957. The 57 papers contributed to the Conference by 75 eminent workers in the field have been divided into 11 sections dealing respectively with Photochemical principles, Photocontrol of seed germination and vegetative growth by red light, Role of chemical agents in photocontrol of vegetative growth, Photoperiodic control of reproduction in plants, Growth factors and flowering, Analysis of plant photoperiodism, Relation of light to rhythmic phenomena in plants and animals, Photoperiodism in the invertebrates, Photoperiodism in vertebrates, Photoperiodic control of reproduction and migration in birds and control of periodic functions in mammals by light.

Proceedings of International Conferences on selected topics of science make on important contribution to the literature on science subjects. Such Conferences and Symposia bring together workers in different disciplines of fundamental science and their contributions bring up-to-date the advances made in that field. The publication of the proceedings enables other workers to get acquainted with techniques, results and problems which would become unavailable otherwise. To workers familiar only with a very minor portion, namely the effect of day-length in inducing or delaying flowering in plants, this book will be a revelation to see the advances that have been made in several aspects on the subject of photoperiodism.

It is the astronomical phenomenon, namely, the inclination of the earth's axis of rotation to the plane of its orbit round the sun which underlies the phenomenon, and the rhythm of seasons is due to this important characteristic of our planet. The 24-hour cycle of earth's rotation is divided unequally into photoperiod and dark period in different latitudes, and this duration continuously varies with the march of season. Concomitant to changes in photoperiod, prevailing temperatures also change and such a rhythm has persisted over geologic time. Life in general has evolved under these conditions and has adapted itself to it. The chief contributions in the book relate to the nature of photoreaction, the possible biochemical pathways and the types of response in divergent

organisms. Even man is not immune to this as shown by the interesting paper by Halberg *et al.* on mice and men at the end of the book.

It is hard to pick out the most salient points from the book since every paper is an important contribution. Perhaps reference may be made to some of the topics. No pigment is identified as a photoreceptor in plant. It is very probable that there is an endogenous rhythm in plants as well as in animals, and growth is closely connected with this rhythm. Photoperiodism influences the rhythm, and patterns of growth are correspondingly changed. The concept of a "Clock" or a system measuring seasonal time is postulated by several workers and Withrow gives estimates of the sensitivity of the mechanism involved. This concept of a clock has been treated in detail by Hastings and Sweeney from studies on the *Gonyaulax*, an armoured marine dinoflagellate that is both photosynthetic and luminescent (pp. 567-584). Pittendrigh and Bruce discuss the physical concept involved and postulate ESSO system (endogenous self-sustaining oscillation). Studies on photoperiodism in birds have revealed the part played by hormonal system in the response to changes in day-lengths. The pioneer work of Rowan in Canada has been widely confirmed and extended to insects.

Parallel attempts to identify the part played by hormonal system in plant photoperiodism has proved difficult. The experimental work on this topic is widely covered by the contributions in the book. The papers on photoperiodic processes and on chemical nature of the induction process by Bonner (pp. 245-254 and pp. 411-422) give critical account of the problems and progress made pertaining to plants. He has also suggested the Mnemonic device HPTSTI (the letters standing respectively for initial high intensity light reaction, pigment decay, time measuring, hormone synthesis, stabilization, translocation and induction) to remember the Catenary sequence of processes in plant flowering. Hendricks (pp. 423-437) discusses the photoreaction and also the possible pigment involved.

The book is a valuable publication and should be recommended as an important reference to all workers in photoperiodism. Often the ingenious techniques followed in controlled experiments should prove particularly valuable for research workers.

K. R.

Biology of the Pleuropneumonia-like Organisms. Editor-in-chief: Otto v St. Whitelock. *Annals of the New York Academy of Sciences*, Vol. 79, Art. 10), January 15, 1960. Price $ 5.00.

The monograph under review is the result of a Conference on *Biology of the Pleuropneumonia-like Organisms*, held by the Academy on January 14, 15 and 16, 1959. Many scientists and researchers in the field from U.S.A., England, Denmark, Germany, Netherlands, Canada, Australia, Spain, Mexico and France participated in this Conference. As such the importance of the papers presented and the details of the proceedings and discussion on the present state of knowledge on "Organisms of the pleuropnemonia group" is quite obvious.

The Conference Chairman, D. G. ff. Edward's introductory remarks very aptly and vividly point out in general the importance and complexities involved in the studies of this group of organisms.

The monograph has been divided into seven parts.

The first part (seven papers) deals with the morphology and classification of the pleuropneumonia-like organisms (PPLO) on its various aspects. Part II (nine papers) is concerned with isolation and propagation of these organisms. Part III contains papers on relation of (PPLO) to bacteria and reversion of avian pleuropneumonia-like organisms to bacteria. Part IV presents seven papers on the physiology of the organisms of this group. Part V comprising of 7 papers deals with serology and chemotherapy. Human pathology is the subject-matter of Part VI with the contribution of eight papers embracing various syndromes possibly related to (PPLO). Part VII is concerned with animal pathology which prompted the recent phase of intensive study and interest in this group of organisms. Eleven papers are presented in this part dealing mainly with the association of (PPLO) to chronic respiratory diseases of poultry.

The discussions at the end of each part have added significantly to the understanding and latest developments on the topics concerned.

C. M. SINGH.

Preservation of Fruits and Vegetables. By Dr. Girdharilal, Dr. G. S. Siddappa and Sri G. L. Tandon. (The Indian Council of Agricultural Research, New Delhi), 1950. Pp. 358. Price Rs. 11·50.

The Fruit and Vegetable Preservation Industry in India is still in its infancy and for its

development into a major industry in the country, we require adequate scientific knowledge on the practical aspect of preservation of our indigenous fruits and vegetables. At the instance of the Indian Council of Agricultural Research the authors who belong to the Central Food Technological Research Institute, Mysore, and are known for their own researches in this field, have brought out this useful publication.

The book opens with a chapter dealing in detail on the principles of food processing, containers for packing, and includes chapters on commercial canning of fruits and vegetables along with notes on the building, machinery and equipment required. It deals with the causes for spoilage in canned foods and the methods of controlling them. Detailed methods of preparations, along with the recipes for the manufacture of fruit juices, squashes, cordials, fruit beverages, candies, fermented beverages, jams, jellies, marmalades, preserves, crystallised fruits, tomato products, chutneys, sauces, pickles, vinegar and other by-products like cheese, pectin, etc., etc., from various kinds of fruits and vegetables grown in our country are given. The book is so exhaustive on the subject that it deals in detail even on the qualities of water required for a cannery, food colours that could be used and those which are banned, the effects of processing on vitamin contents of the preserved products and how best to minimise their destruction in processing.

Reference tables required in fruit and vegetable preservation and the "Fruit Products Control Order 1955" are also included in the book. The many features briefly enumerated above make the book not only a guide for those who want to start a commercial fruit and vegetable canning factory, but also an asset to the Extension workers, Home Science Colleges, and even housewives.

In short, it aims to promote the interests of the Horticulturists in the country. The book is well got up and priced not too high.

C. Bhujanga Rao.

Books Received

Memoirs of the Society for Endocrinology No. 8).—*Quantitative Paper Chromatography of Steroids.* Edited by D. Abelson and R. V. Brooks. (Cambridge University Press, London, N.W. 1), 1960. Pp. vii + 103. Price 30 *sh.*

British Medical Bulletin—The Thyroid Gland, Vol. XVI, No. 2 (The Medical Department, The British Council, London W. 1), May 1960. Pp. 89-174. Price 20 *sh.*

Methods in Geochemistry. Edited by A. A. Smales and L. R. Wager. (Interscience Publishers, New York, N. Y.), 1960. Pp. vii + 464. Price $ 13.50.

Design For a Brain—The Origin of Adaptive Behaviour. 2nd Edition. By W. Ross Ashby. (Chapman & Hall, London, W.C. 2 ; India : Asia Publishing House, Bombay-1), 1960. Pp. ix + 286. Price 42 *sh.*

Principles of Animal Virology. 2nd Edition. By F. M. Burnet. (Academic Press, New York ; India : Asia Publishing House, Bombay-1), 1960. Pp. ix + 490. Price $ 12.00.

The Symposium on Thyro-Gonad-Adrenal-Pituitary Relationships. (National Institute of Sciences of India, Mathura Road, New Delhi ; Publications Section : 1, Park Street, Culcutta-16), 1960. Pp. xi + 131. Price Rs. 10·62.

The Wealth of India, Part V (I-L).—*Industrial Products* (Council of Scientific and Industrial Research, New Delhi-1), 1960. Pp. xiii + 289. Price Rs. 30·00.

Analytical Dynamics of Particles and Rigid Bodies (Paper Edition). By E. T. Whittaker. (Cambridge University Press, London, N.W. 1). Pp. xiv + 456. Price 30 *sh.*

Discovery Reports, Vol. XXX.—*The Distribution of Pelagic Polychætes in the South Atlantic Ocean.* By Norman Tebble. (Cambridge University Press, London, N.W. 1), 1960. Pp. 161-300. Price 63 *sh.*

Report of the Rothamsted Experimental Station for 1959. (Rothamsted Experimental Station, Harpenden, Herts), 1960. Pp. 288. Price 10 *sh.*

Some Mathematical Methods of Physics. By G. Goetzel and Nunzio Tralli (McGraw-Hill Book Co., New York-36, N.Y.), 1960. Pp. xiii + 300. Price $ 8.50.

An Outline of Man's Knowledge of the Modern World. Edited by L. Bryson. (McGraw-Hill Book Co., New York-36, N.Y.), 1960. Pp. xii + 692. Price $ 7.50.

The Plasma Proteins, Vol. I—*Isolation, Characterization and Function.* Edited by F. W. Putnam. (Academic Press, New York ; India : Asia Publishing House, Bombay-1), 1960. Pp. xv + 420. Price $ 12·50.

SCIENCE NOTES AND NEWS

New Host Record of *Dacus zonatus* Saund (Trypetidae-Diptera)

Shri Joginder Lall Nayar from St. John's College, Agra, reports that the fruit flies, *Dacus zonatus* Saund and Carpomyia Vesuviana Costa, occur together on the 'ber' fruit (*Ziziphus jujuba*).

Award of Research Degrees

The Andhra University has awarded the D.Sc. Degree to the following in the subject and for the thesis noted against each: (1) V. Lakshminarayana in Nuclear Physics for "Interaction of Gamma Radiation with Matter"; (2) K. V. Jagannadha Rao in Chemistry for "Chemical Examination of Indian Medicinal Plants"; (3) V. V. Jagannadha Sarma in Geophysics for "Laboratory and Field Studies in Relation to Electrical Resistivity Prospecting"; (4) P.S.R.K. Haranath, in Pharmacology for "Passage of Adrenaline from the Blood Stream into the Cerebral Ventricles and Subarachnoid space and of Histamine from the Cerebral Ventricles into the Blood Streams and into the Brain".

Symposium on 'Light Metal Industry in India'

A Sysmposium on "Light Metal Industry in India" will be held under the auspices of the National Metallurgical Laboratory Jamshedpur, in early February, 1961.

The scope of the Symposium will broadly cover the following with reference to light metals and their alloys: raw materials, metallurgical techniques and technological advances, recent developments in heat-treatment, physical metallurgy of light metals and their alloys, the role of light metals and alloys in metallurgical and chemical engineering and nuclear reactor technology, and present status and future expansion of light metal industry in India.

Seminar in Electrochemistry

The second seminar in Electrochemistry at the Central Electrochemical Research Institute, Karaikudi, will be held in the 4th week of December 1960.

Scientific workers in this field who wish to take part in the seminar should send three copies of the abstracts of their papers (about 300 words) by the 15th October 1960 and two copies of the full paper by the 15th November 1960. Further particulars can be had from Dr. H. V. K. Udupa, Convener and Assistant Director, C.E.R.I., Karaikudi-3 (Madras State).

National Institute of Sciences of India

The National Institute of Sciences of India which was established in January 1935 will celebrate its Silver Jubilee from 29th December 1960 to 2nd January 1961 at New Delhi. The programme of the celebrations will include lectures, symposia and exhibition of scientific publications. Besides, a special Souvenir volume, containing original contributions on scientific subjects by the Fellows of the Institute, will also be issued.

Fuel Research in Australia

The Annual Report of the Division of Fuel Research of the Commonwealth Scientific and Industrial Research Organization (C.S.I.R.O.) brings out the progress of research in this field in Australia over the past year.

Coal represents one of the most valuable natural assets and the principal energy source of Australia. Reserves of the more valuable types of coal are limited, and to use them to best advantage it is essential to widen our knowledge of their properties by research.

The Organization's main establishment for research on fuels is at the Division of Coal Research, North Ryde, New South Wales. The Division is engaged in research on the physical and chemical characteristics of coals from all parts of the Commonwealth, using up-to-date scientific techniques such as X-ray diffraction, mass spectrometry, ultra-violet and infra-red spectroscopy and vapour-phase chromatography. These intensive researches throw new light on the constitution of coal as a means of developing non-fuel uses such as the production of chemicals.

The Report shows the progress achieved during the year on carbonization investigations. Coke, both as fuel and as chemical reducing agent, is an important raw material in the ferrous and non-ferrous metallurgical industries. The Division has shown how to make better cokes by blending with Australian coals various carbonaceous materials, of which fluidized-bed char has proved the most satisfactory.

The Report also shows the continued progress made during the year in systematic assessment of Australian coal resources. In the past year this has been concerned mainly with Queensland coals and has yielded data with an important bearing on coal exports. An Associated study has been concerned with the nature of the

ineral-matter content of brown and bituinous coals with a view to find out the suitility of untreated Australian small coals for ring in cyclone slagging furnaces.

luorescence Technique for Measuring Littoral Drift

The Hydraulics Research Station, D.S.I.R., at allingford, Berks, has developed an interesting chnique for measuring, by means of fluorescent acers, the rate at which pebbles or sand drift ong a coastline (littoral drift). A knowledge this rate of drift is of importance to the astal engineer, but hitherto no generally tisfactory methods have been available for etermining it. The technique employs a acer material (Rhodamine B), which glows nder ultra-violet light, incorporated in artiial pebbles or sand grains.

By measuring periodically the spread of the acer material along a beach the rate of drift n be calculated. With a pebble beach, the acer pebbles are counted at night under ultraiolet light. With a sand beach, samples are ken and the concentration of tracer particles etermined. The calculated drift will be comared at the end of a year with the actual drift Rye, since here shingle drifts towards the estern breakwater of the River Rother and iles against it; the actual quantity of drift n be measured by finding the rate at which ingle would have to be removed from the eakwater to maintain a constant beach line. he results obtained so far are promising.

Similar experiments are being made on shingle aches at Deal and Dungeness, and preliminary periments have begun on a sand beach at awlish Warren in Devon.

riboluminescence in Mercury Bubbler

When different gases are allowed to bubble rough mercury (several millimetres deep) ntained in a pyrex or quartz vessel at atmoheric pressure weak luminescence may be served in the region above the surface of e liquid. The extent of the glowing region, hich appears to consist of numerous small shes of light, may be several centimetres ove the liquid surface depending on the rate flow of the bubbling gas. The observed ght emission is an example of triboluminesence initiated by the hydrodynamic interaction etween a flowing gas and a liquid. In the ercury bubbler, electrostatic charging of ercurry droplets takes place in the process bubble formation and disintegration. he luminosity observed is the result of e discharge between the charged droplet and the surrounding silica surface. The brightest emission is found to occur when helium and argon are employed as the bubbling gases. A spectroscopic investigation of the luminescence shows the bands of N_2 and N_2^+. The resonance line of mercury λ 2537 is a prominent feature of the spectrum. It is significant that the bands of N_2^+ are observed only with helium as the bubblant and not with argon. This implies that in the production of nitrogen bands the metastable rare gas atoms act as an intermediate species in the transfer of energy to the nitrogen molecule from excited mercury atoms.—*Canad. J. Phys.*, 1960, 38, 967.

Very Low Temperature Gyroscope Project

The phenomenon of superconductivity, the disappearance of all electrical resistance in metal at very low temperature, is exploited in an ingenious gyroscope under development in the General Electric Research Department, Schenectady U.S.

A hollow niobium golf ball, of 4 cm. diameter, serves as the gyro rotor which is supported by electromagnetic flux and rotated in a vacuum. This is possible because a magnetic flux will not penetrate a superconductor. Consequently, at temperature in the region of absolute zero, magnetic field can be used to suspend a rotor free from its bearings so that it spins without friction. Clearance between the ball and its cage is 0·3 mm. The chamber is evacuated to 10^{-6} or 10^{-7} mm. of mercury. A winding in the bearing gives a rotating flux that spins the ball at about 20,000 revolutions per minute. The system is cooled to 4° K. by liquid helium.

It is expected to complete and test an engineering model of the gyroscope in the course of this year. The new gyroscope will be many times more accurate than the types now in use due to absence of mechanical bearings, reduced frictional and electrical losses, and greater dimensional stability. It is claimed that such a device will enable a submarine to remain submerged five to ten times as long as it is now possible before it has to surface and check its position. Other potential applications are in navigation systems for land vehicles and guided missiles.—*I.S.L.O. Newsletter.*

Sun as Relay for Radio Signals

Following the successful experiments in which the Moon has been used as a Relay station for radio communication (see *Curr. Sci.*, 1959, 28, 348) between places on the earth, it has now been shown that it is technically feasible with presently known transmission techniques to use the Sun as a huge reflector to relay radio signals

between distant points on the earth. Experiments have proved that radar pulses bounce off from the Sun. It may likewise be expected that the solar atmosphere of ionized gases also can reflect coded radio signals with sufficient reliability for relaying limited amounts of data. Successful accomplishment of this would require a system including large antennas, powerful transmitters, and advanced electronic data-handling equipment.

According to D. J. Blattner of the RCA Laboratories, signals transmitted at a frequency of 40 Mc./s. would be reflected from the corona which forms the outermost portion of the Sun's atmosphere. Such a system would require a transmitter with a power output of about one million watts, and a 120 ft. parabolic antenna capable of following the Sun across the sky. To overcome the spurious noise created by the solar atmosphere Blattner suggests the use of 20-second pulses for communicating coded information. This would necessarily limit the speed of communication, about half an hour for a complete word. Further, the signals would take 16 minutes to cover the round-trip distance between the earth and the Sun, travelling at the speed of light. Nevertheless such a system would provide an alternate means of relaying useful amounts of coded data at times when the Moon is not available.—*J. Frank. Inst.*, 1960, 269, 502.

Chromosome Abnormalities in Man

The year 1959 will be remembered for an important breakthrough in the young science of human genetics. This was the discovery that certain congenital abnormalities in man are due not to "point mutations," that is mutations involving only a tiny fragment of a chromosome, but to the addition or loss of whole chromosomes.

Genetically determined abnormalities are essentially due to mutations, *i.e.*, sudden changes in genetic material, which may occur naturally, though similar changes may be brought about artificially by ionising irradiation or certain chemicals. Most mutations in animals and plants are "point" mutations, that is to say, though their effects on development may be dramatic, producing more or less severe abnormality, no change is apparent on examining the chromosomes. Many of the mutant genes, too, may revert back to the normal form, indicating that the basis of the mutation is some small change.

Some mutations, however, are accompanied by visible changes in the chromosome. These vary from the addition or loss of whole chromosomes to the addition or loss of a small fraction of a chromosome. Investigations on fruit-fly and other animals have shown that loss of an appreciable fragment, say, a fifth, of an average-sized chromosome is not compatible with life. The presence of extra fragments of chromosome, however, is better tolerated, though resulting in some degree of abnormal development, and in plants a number of examples of individuals with one extra chromosome have been studied. These "trisomics" have the chromosome number $2n + 1$, and one chromomsome is present in triplicate, not paired.

Until a few years ago the cytology of man was undeveloped and even the chromosome number had been wrongly counted. For over 30 years this had been taken to be 48, that is 24 pairs. While the total number was thus wrongly assessed, it was not to be expected that abnormalities could be detected.

In the last few years a number of technical advances have been made which make more accurate counts possible. The first is an improvement in the stain used to show up chromosomes selectively. The second is a technique of squashing the cells to spread out chromosomes; the third is the use of colchicine. This drug, long used in plant genetics, has the valuable property of arresting cell division at a stage when the chromosomes are widely separated. In 1956 Tjio and Levan, using tissue cultures from aborted human embryos, shortly followed by Ford and Hamerton, using preparations from male gonads, were able to show that man had 23 chromosome pairs.

Early in 1959, the new techniques of chromosome counting were applied to mongols (persons showing physical peculiarities known as "mongolism") and it was found that the dozen or so patients examined all had 47 chromosomes. The extra chromosome was very probably a third member of the 22nd or 23rd pair, which are the smallest chromosomes and cannot at present be distinguished.—*Science Progress*, 196[illegible] 48, 232.

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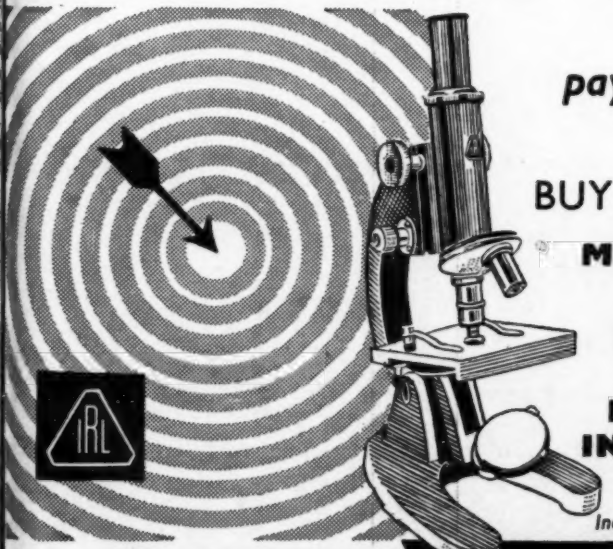

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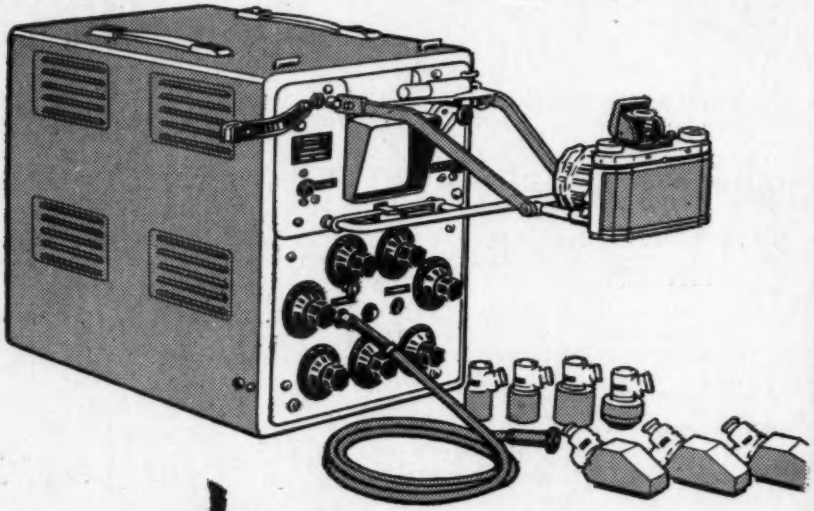

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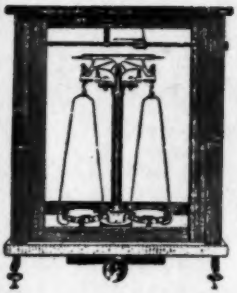

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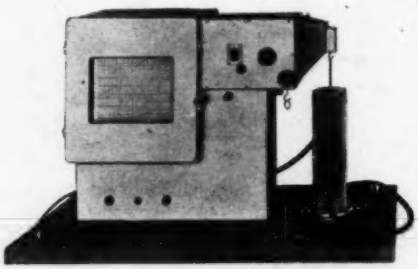

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